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How Low Inventory?

STOCKS OF TOOLS AND SUPPLIES have been reduced to the vanishing point by a prolonged period of hand-to-mouth buying. Will this policy be continued in the face of increased industrial activity and rising prices? Or will minimum order points be restored and reasonable inventories built up? Informal interviews with men responsible for industrial buying indicate that a change in sentiment has already taken place.

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A GOOD MANY things have changed since the boom days of 1929, and the buying of shop tools and supplies is no exception. When large inventories were in vogue, the operator was seldom disappointed when he called at the toolcrib for a standard drill, tap or file, and the maintenance crew had no trouble in getting belting, oil or paint at a moment's notice.* The stockroom worked on a maximum-minimum basis and functioned smoothly.

An informal survey of a number of shops shows that today buying methods and inventory control are quite different. But other than a general tightening up of purchases and a reduction of the minimum limit, there is little similarity in the various procedures now in use. Each shop seems to have attempted to work out a plan to suit its particular needs and resources. These plans range all the way from a skeleton of the former system to the elimination of all system by the adoption of strict hand-to-mouth buying.

To give an instance of the extremes to which this latter practice has been carried, one small shop makes no effort to plan ahead but waits until the operator calls for the tool before issuing an order. Thus if a ⅞-in. drill is needed for a particular job, nothing is done until the operator gets to the ⅞-in. hole. The purchasing agent prides himself on getting quick delivery through one source or another and often has the company's own truck pick up the needed tool. Experience with deliveries has been good—usually the wait is for a few hours only. Meanwhile, the foreman reassigns the man to another job, perhaps another machine, and seeks to minimize the lost time.

Of course, some time is lost and some deliveries are delayed, but in defense it is claimed that no help is needed to operate the system, since there is none, and that the old inventory of tools and supplies is depleted to the utmost. The executives get to the office at the same hour as the workmen and are ready to give immediate attention to small items. Tools are bought singly and steel in short lengths although the cost is greater. Of course the shop cannot be choosey about the kind of tools or supplies it gets—delivery is paramount.

Large or medium-sized shops have not gone this far, apparently because the law of diminishing returns makes the practice unprofitable. One can readily imagine the lost motion that would ensue if every tap and file were a special purchase in a good sized plant. However, the hand-to-mouth principle is ap-

proached somewhat even in the larger establishments.

A large electrical manufacturer still keeps some of his minimum order points but has cut his inventory by 75 per cent. On about half the items, where the tools are less frequently used, the minimums have been canceled altogether. One of the saving elements in this plan is a thoroughly competent tool crib man whose knowledge of the plant and its requirements has made possible the drastic inventory reduction.

Standard Tools Popular

This plant does standardize on certain brands of tools, sometimes because of long experience but more often on the basis of tests which were made in past years. The management is reluctant to depart from this standardization even though many of the tests are admittedly old, but it will do so when an important improvement or development has been made.

Another large plant, engaged in engineering manufacture, not only insists on certain brands of tools and supplies but continues to conduct tests when these appear necessary. A file test, for example, has just been completed and upon its results the company will make future purchases. In this plant, an equipment engineer has the responsibility for the selection of tools both special and standard. The inventory has been greatly reduced, but because of the wide variety of product, tools and supplies cannot be stocked with a definite period of time in view.

This is done, however, by a medium sized concern working on a quantity production basis, but the 90-day supply formerly carried has been cut to a 30-day supply. The management claims it can never see more than six weeks work ahead and cannot be positive that changes in product, which will call for different sizes of tools, will not be made within that period. However, continuous production is important, and the minimum is being maintained on all current items.

This company buys from a number of suppliers, according to best conditions of price and delivery, but attempts to standardize as much as possible on a few specific makes. Preferences are usually based on experience rather than test.

Minimums have been eliminated from the record cards in another large electrical manufacturing concern, but a record is kept of the supply on hand, the monthly consumption and the placing of orders. A man formerly in charge of all the storerooms watches the cards and releases the orders, using his best judgment and knowledge of deliveries. On the present basis of quick deliveries and limited needs, this plan has proved adequate, but it is planned to return to the minimum order point when business improves.

Since this company has branch plants in other parts of the country, it maintains a surplus list of tools and supplies in its main office. This office acts as a clearing house for the several plants, enabling one plant to use the excess supplies of the others. Some of the purchasing contracts are made by the main office, and while the plants do not necessarily have to use these suppliers, it is usually advantageous for them to do so. This company also has a central research department to test tools and supplies and even sends a representative around to the manufacturers of these products to obtain a first hand view of their quality. One other plant visited uses the same method of home office contracts. In this instance, however, the list of suppliers was quite large, almost all standard makers being included.

Policies in interviewing salesmen also differ greatly. In every case there is a disposition to treat salesmen fairly and to give them an opportunity to tell their stories, but this is subject to practical limitations. Shop supervisory personnel has been reduced to a point where those who are left are kept busy. The volume of work may be low, but the loose ends a works manager or a superintendent has to keep track of are as numerous as ever; and because he has much less assistance, these duties consume his time.

One in Ten Gets In

In one shop, the general superintendent sees about one salesman in ten; the rest do not get by the purchasing department although the actual selection of tools and supplies is done by a shop committee in which the departmental foremen have a strong influence. Many of the salesmen who do get into the shop are invited in by the superintendent because of some new announcement which has been made regarding their product.

In no instance were the salesmen allowed to get into the shop without obtaining permission from either the superintendent or the purchasing department head. The purchasing department often acts as a buffer and attempts to weed out the salesmen who have nothing to offer in the way of new developments or technical information. One production shop, however, while conserving the time of its foremen against purposeless calls, welcomes the better salesmen and gives them an opportunity to interview the foremen. This is also true in some of the larger electrical manufacturing plants.

Even today price is not usually the deciding factor in industrial supplies. Most managers are of the opinion that the variations in quality are far greater than those in price and are willing to pay a little more to get tools and supplies which have proved their worth under test or in production.

The salesmen selling shop supplies today are of a better type and know more about their business than those of a few years ago. Two plant managers complained that supply salesmen were still below machine tool men in knowledge of their product and were correspondingly less well equipped to render real advisory service. But purchasing agents, who have contacts with many kinds of salesmen, state that those handling shop supplies compare well with others who call upon them.

Concentrated Sales Effort

One small shop using hand-to-mouth buying has noticed an abrupt falling off of salesmen's calls since the first of the year. Some of the larger plants state that the reverse is true, that calls from supply salesmen are more frequent. It might be concluded from this that sales calls are concentrated more in plants that have proved remunerative.

There is a general feeling in most plants visited that present buying practices are temporary expedients, necessary for the moment but inadequate for anything like normal production, and that increased activity will make it necessary to restore minimum order points. Because of the prompt deliveries obtainable no apprehension was found concerning the likelihood of suffering a severe tie-up because of the shortage of a needed tool or supply, but it is realized that this might occur if larger quantities were demanded. It is admitted that even today a buyer has to look a little further when seeking a particular size of tool. Excess stocks of closed and inactive plants have largely been absorbed.

Practically without exception, plant managers anticipate an imminent increase in industrial activity. Operations in one large plant have advanced to 42 per cent of capacity from a far lower figure. The works manager of another company states that his industrial sales have increased every week for the past two months. This concern has made it a practice to weed out its old equipment at its book value, thus accumulating a cash reserve which will be used for new purchases. It is ready to go ahead as soon as the forward trend is a little more pronounced. Still another manager is expanding operations and states

definitely that further betterment in general business will release a flood of industrial buying.

In every instance the path is left open to the salesman who has something new to say or sell. Routine calls of order takers are somewhat of a problem, and in self-defense most executives have had to handle them in the most expeditious manner. But shop men are vitally interested in cost reduction and are more willing than ever to listen to the salesman who can help them in reaching this objective.

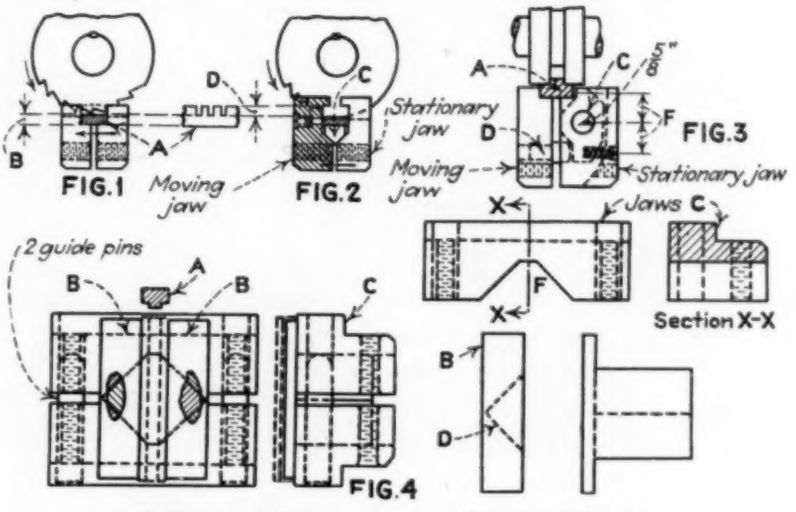
Vise Jaws *vs.* Milling Fixtures

C. W. HINMAN

A positive tool for holding work in the milling machine is a good machine vise that can be fitted with jaws to accommodate themselves to work of reasonable irregularity. Of course, where pieces in multiple and varying slightly in size must be held, shouldered pins floating in soft wax in a chamber in one of the jaws, have an advantage.

Machine vises are comparatively cheap, and auxiliary jaws for them can be quickly made. I have seen many fixtures in use that could have been replaced by machine vises fitted with properly designed auxiliary jaws at half the cost. That special fixtures can be clamped more quickly than can a vise may not always be true, because there are many vises on the market that are operated by quick-acting cams, or by compressed air.

Swivel vises permit cuts to be made at any angle and jaws can be made for them to hold work at least 12 in. long, and supports can be arranged for the outboard ends to prevent chatter. Very long work is sometimes held in two vises placed side by side at a distance commensurate with the length of the work. There is no reasonable limit for either the height or the thickness of the jaws. For work that is wider than the vise opening, overhanging jaws can be designed. The movable jaw can have an equalizing plate attached in front and can be pivoted at its center, thus compensating for both vertical and horizontal variations in the work, so that either the width or the thickness, or both, may taper in either direction without interfering with rigid clamping. Any fastening, swinging stop, or feeler-gaging posts for set-ups, as used in milling fixtures, are applicable to properly designed vise jaws.



Milling machine work can often be held in modified vise jaws as well as in a special fixture

In Fig. 1 is an end view of a pair of plain vise jaws for holding the hard rubber or fiber work *A* while slots in multiple are being milled by a gang of cutters. In this set-up, the dimension *B* will obviously be constant in all pieces, any variation in the thickness of the work being in the depth of the slots. An end view of a pair of jaws that reverse this condition is shown in Fig. 2. In closing the movable jaw, the angular block *C* forces the work up against the overhanging ledges at the tops of the jaws. The spring-actuated pin shown in the movable jaw causes the work to register against the stationary jaw before the angular piece forces it up against the overhanging ledges. After milling, the dimension *D* will be constant in all the pieces and any variation will be in the thickness of the part below the slots.

When equalizing, or self centering jaws are necessary for milling the tongue *A* central with the body of the work where the width of the work varies, the device illustrated in Fig. 3 can be used. The rocker jaw is secured in a chamber in the stationary jaw by the fulcrum pin *C*, which is centrally located between the contact point of the rocker jaw and the thrust pins *D* in the movable jaw, as indicated by the equal distances *F*, in Fig. 3. Coiled compression springs hold the clamping part of the rocker jaw open when the vise is not closed upon the work.

As the movable jaw is being closed, the thrust pins contact with the lower part of the rocker jaw, moving its clamping part with the same speed as that of the movable jaw. It will thus be seen that these jaws close together equally, positively and parallel, and that after the tongue has been straddle milled it will be in the center of the work, regardless of a slight variation in the width of the work. The set-up is made by the aid of a templet block having the same cross-section as that of the work.

In Fig. 4 is shown another simple design of equalizing jaws. These jaws are of the overhanging type, as shown by the shoulders in the end view. The work *A* is clamped between the two auxiliary jaws *B*, which are at right angles to, and are operated by, the regular jaws *C*. Projecting from the bottoms of the auxiliary jaws are pieces *D* having an included angle of 90 deg., which engage pockets of like angle in the bottoms of the regular jaws. As the vise is being closed, the auxiliary jaws are caused to approach each other equally by reason of the angular slip of the projections *D* in the pockets in the bottoms of the regular jaws; therefore, the work is centrally clamped. A compression spring can be inserted between the auxiliary jaws to open them automatically as the vise is opened.

A New Use for the Automatic Center Punch

CHARLES HOMEWOOD

A new use was found for the automatic center punch by attaching a small chisel point in place of the center punch. With the chisel point in place, the tool is convenient for marking fine lines on light, delicate parts, such as the mounts of camera lenses and also for re-marking worn lines on the micrometer collars of machines. The lines so marked will be of uniform depth because of the constant weight of blow of the tool.

Panoramic view of Kaganovitch bearing plant ready for operation

Bearings for the Soviets

FRANK SCHUBERT

Part III—Plant Layout and Construction Selection of Equipment

Operation of American, German and Italian machine equipment in the same plant offered a good opportunity to compare their relative merits. American tools showed up well at Kaganovitch where the facilities are at least equal to those in any other bearing plant

THE KAGANOVITCH Bearing Plant is located at about the south-east corner of the City of Moscow on an unusually sandy bluff, jutting west and north in one of the numerous bends in the Moscow River. At one time the land thereabout was the holding of a monastery, but it is now dotted with factories and apartments. The Moscow Belt Railway, serving the old Moscow packing house, has a siding cutting through the bearing plant plot at its north end, and a larger line, serving a small station—Oogreshkaya—skirts the foot of the bluff at the southern boundary of the plant property. The packing house, about a mile east of the bearing plant, has been expanded recently into the largest one in the Soviet Union.

One mile south of the packing house, on Ostapovskoye Boulevard, is the principal toilet-soap factory of Russia. Across the railway to the south of the bearing plant is an old chemical works. Across the belt siding to the north is an asphalt plant. Across the street to the east is the Moscow assembly plant for "Ford" Models A and AA. At the northwest corner and across the street is the Non-ferrous Metal Institute. Farther to the west are the Amo Truck Plant and the Hammer and Sickle Steel Works, with the motorcycle and bicycle plant to the southwest.

Winds from the east and the south brought a wealth of odors. On foggy nights, quite numerous in the fall, and on dewy evenings in the spring, considerable trouble was experienced with rapid rusting of ground bearing rings and polished or un-painted machinery parts. This required such extraordinary precautions in the use of slushing compounds, that the removal of the chemical plant was being discussed last summer, as the more economical means of overcoming the difficulty.

From the siding of the Belt Railway three spurs extend into the plant, the eastern one serving the Tool and Forge Divisions, the middle one the auxiliary building and the small parts section, and the western one the shipping room, all being under roof after they reach the northern building line. An auxiliary spur is to jut from and at right angles to the main middle spur to serve the fuel oil storage tanks, to avoid blocking of the main spurs. Since the majority of the Russian freight cars, like those in other continental countries, have fixed axles, the spurs must have extra large radii, as an American would view them. This results in considerable loss of ground area and requires the main flow of product through the plant to be from east to west.

As mentioned in the first of these articles, three proposed plant layouts were made in America. When the Staff had returned to Moscow, however, the technical assistance contract with Officine Villar Perosa was in force, and their Architect Ciocca of Milan had pre-

pared a different layout, which after some changes by the State Project Organization (partially staffed by Kahn Engineers) was finally adopted. The basic differences between the Italian and the American plans were the increase in total floor space, the connecting of all productive and non-productive manufacturing units by roofed corridors, and the shifting of the bearing assembly section to head the small parts section rather than the ring grinding section.

All units of the plant proper are of monitor type, with the exception of the auxiliary building, the forge shop and the annealing department. The office is of the multiple-story flat-roof type. The auxiliary building is a high arched-roof bay placed between the tool and the small parts divisions. The forge shop consists of four long east and west, separate craneway bays, the floors being free of all columns or other obstructions. These bays are connected at each end by north and south bays also served by overhead cranes. The eastern connecting bay serves as covered track, unloading platform and bar stores. The western connecting bay serves as the annealing department. These bays have high arched roofs, on which are mounted longitudinal monitors.

Patience, tact and ability are essential traits in a machine demonstrator in Russia. Here is a group of Italian and German demonstrators and specialists

The so-called monitor units run east and west parallel to the forge shop bays and have a column spacing east and west of seven meters and north and south of twelve meters. Through the monitor units, in a north and south direction, run two-story sections, one bay wide, except in the case of the one which serves as the forging stores department and the one which heads the plant just in the rear of the office building, these being three and two bays wide respectively. These north-south sections are not divided off from the ground floor, except at the heat treating section and at the annealing department, but they do serve for a grouping on the ground floor of the motor driven heating blowers, which are of the steam coil stack type. Their second floors provide corridors for access to various sections of the department, as well as providing space for service rooms, libraries, social rooms and departmental lunch rooms. They connect with the main east-west corridor at about the center of the plant.

This main corridor which begins at the main factory entrance (at the north end of the office building) is also two stories in height and runs the entire length of the plant. Its first floor serves for unrestricted transportation of materials and supplies as well a free runway for ambulance and fire patrols. Its second floor is lined on both sides with narrow service rooms, but is intended as an unrestricted "street" for foot passage only. Since this "street" connects with the north-south sections, all factory employees have easy access to their machine or bench assignments without passing through any other department or section, and with a minimum of walking through their own departments. All corridors being under roof, once an employee has reached the main factory entrance there is no necessity for his leaving the shelter of the roof in inclement weather. Unfortunately it was essential to begin operations in the factory before access to all of these corridors was available, so eventually some instruction in the proper use of them was necessary. But with the completion of the service rooms, the proper use of the corridors is the natural thing to acquire. These corridor sections also serve to eliminate all fuel, water, air and heating mains from tunneling productive floor space in the main production plant.

Ideal Working Conditions

No factory employe could ask for more pleasant working conditions than this plant affords, for with its machines driven by individual motors, and with the absence of overhead obstructions, it is like working in a huge plaza shielded from the weather. During the first year only one objection to its general plan developed, and that was in its monitor arrangement. The monitors being of the flat peak, inverted-V type, interrupted at about eight or ten bay intervals by the north-south sections, in the winter some of the roof pockets thus formed filled up with snow cutting off considerable light and creating some chances for seepage. In the summer, the windows of these monitors facing north and south and sloping easily, permitted long hours of hot sunshine to flood the production floors with heat. The sun rises to a fair brilliance by 3 a.m. and is still fairly warm at 7 P.M. It is possible, when facing north in the dead of a summer night, to see the last faint rays of sunset in the extreme northwest and the first flush of sunrise in the extreme northeast. All windows are double-glazed and the supply of heating steam is furnished by a central or district heating station about one mile east of the bearing plant. Probably the plant unit or "city" will have its own power and heating station by next year, when all of its "city" units are completed—a community serving in itself the families of 15,000 workers.

Just south of the general office building and facing west will be the hospital and nursery, and just south of that the factory school, giving practical and technical training to from 2,000 to 3,200 students. Enrollment in this school is open only to workers or apprentices in the factory proper, "paper work" employees not being accepted. To the rear of the school is the chemical and physical laboratory group, fully equipped with modern analytical and research equipment, and staffed by an able personnel. Then eastward again from there are the garages and the fire station, and in the extreme southeast corner are two five-story apartments, each facing east and west with a broad plaza and an

orchard (set out in 1932) between them.

Across the boulevard (to be) from the general offices are the workers' cooperative apartments, ten five-story units again facing east and west. To the south of them will be the theater and civic-center and then, on the bluff above the railway is the community kitchen and dining hall. Across the railway and served by a viaduct is another group of workers' houses. The cooperative store will face the boulevard, just north of the main factory entrance.

Although the American design specified concrete and steel construction, there is practically no structural steel in the plant structure as it stands today, reinforced concrete, brick and wood having been used, with a generous allotment of glass, to produce a substantial factory building in a land where structural steel is at a tremendous premium. The foundations, the pilasters, the columns, and the flat roofs are of reinforced concrete.

Early Progress Slow

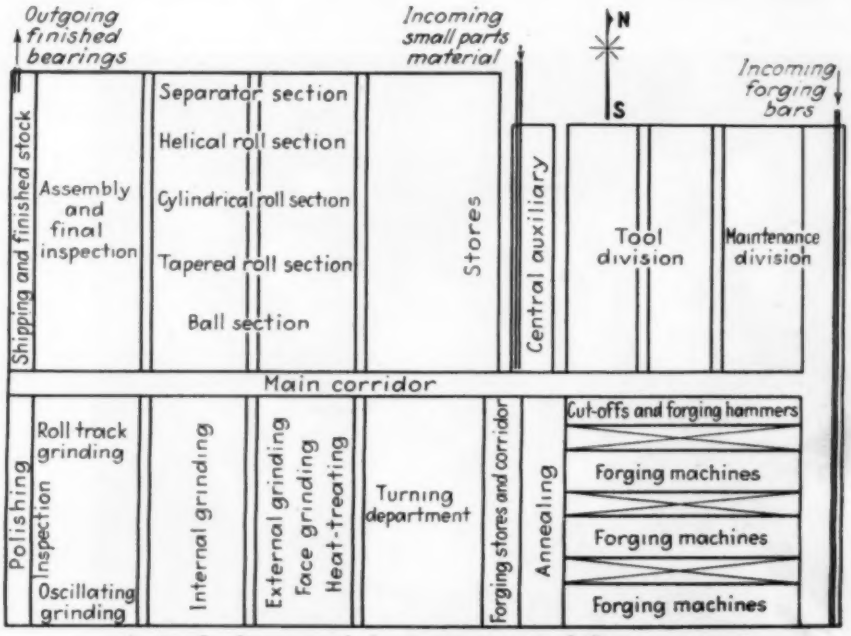
Just before returning to Italy, in November 1930, I inspected the plant site. The two administrative apartments, soon to serve as temporary offices, were plastered and ready for glazing. Also, the school building was about ready for the roof trusses. Some grading had been done, leaving three-foot mounds of sand, capped by a thin top-soil, to mark some of the column locations. By that time it had been decided to proceed with the purchase of only one third of the equipment, to be put into full operation during 1931-32 as a first release. So the 1931 building plan excluded the small parts division, which was the largest of the monitor type units. Winter had set in and so by March 1931 only the foundation and the pouring runways for the tool and repair division were in readiness for the spring building season.

Returning to Moscow in September 1931 I was surprised to see the plant so near completion of the building schedule. The school was finished and in operation, and heating units and machinery were being installed in the tool room, which began operation in November. The production planning department and some of the first production machines were also set up there; but by the last week in December the office building was occupied and the machines were being installed in the main production building. By the last week in January, the first trial run of bearings was finished. During April, May and June of that year they had had a building worker shortage varying from 500 to 1,100 men. During July, August and September, this shortage reached 1,500 men. In spite of this, it was the first time one of the larger plants (approximately one million square feet of it) was built complete and put in operation in one building season. By the end of March, 1932, one year from "scratch", all departments (except heat treating and annealing) were operating sufficiently to authorize the official opening to be celebrated in the usual gala manner. The first bearings made were small and hence pre-annealed bar stock was used for them and they were heat-treated in the school shops.

Since the pre-cast columns for the small parts division were just then being erected, it was necessary to establish those divisions temporarily in the ring finishing division, there being available the space intended for the remainder of the ring equipment just then being purchased. The press department was set up in one of the vacant bays of the forge shop, the ball and the roller divisions were set up in the space between the turning and grinding machines, and the assembly room was set up between the race grinding machines of the roller bearing and the ball bearing sections. All ring equipment delivered was set up in its permanent location. Thus the arranged flow of material was initiated as planned for final operation of the plant.

A schematic arrangement of the flow of material is shown in the accompanying layout. Annealed bar stock for rings up to a finish-diameter of 40 mm., was delivered by the central spur to the five-spindle automatic screw machines in the turning division, since these machines were under the first monitor south of the main corridor and begining at the annealing bay. From there these rings joined the forged rings and moved west in the same manner. Forging bars entered the plant at the eastern spur and moved westward from forging through succeeding operations to final inspection and polishing at the western end of the main building and then north into the assembly room. Hence there was no cross flow of material through any production line.

I believe that this layout was once approached in an American bearing plant where long machine lines were laid out for the complete working of one size of bearing. The layout in Moscow, however, had the machines grouped first as to type or operation, and then as to size; so that as an observer would walk down an east-west aisle he would pass first one group of machines (perhaps turning) of the same type and size set up on the same operation on various sizes of rings of the same type. To his right would be smaller machines performing similar operations, and to his left larger ones. Then as he would go on through the hardening room, he would enter the face-grinding section, and so on. Should he walk through the ring grinding department from north to south at its western end, he first would pass the roll track grinders of the cylindrical roller bearing rings, then the roll track grinders of the tapered roller bearing inner rings, next the ball race grinders of the ball bearing outer rings and finally the ball race grinders of the ball bearing inner rings. This resulted in a straight line flow of material and yet grouped the machines so that super-



A simple diagram of the arrangement of departments at Kaganovitch. Flow of material was carefully worked out

visors and set-up men had their operating territory consolidated in easily patrolled sections.

After the general technological processes had been laid out here, in America, the selection of machines became the making of a decision between two (or perhaps three, if available) different makes of machines for each operation. After visits to some of the machine tool plants and numerous conferences with their representatives in New York, very elaborate comparative charts were prepared showing detailed machine loadings, basic costs, tooling charges, etc., together with detailed descriptions of the machines (if new and special), analyses of their basic differences in construction; and also, where observed, comparisons of material and workmanship. These data were then submitted with the proposed decisions as to vendors. But by the time the staff had reached Moscow, trading conditions with the United States had altered, and the Italian project, varying somewhat from the American, had been submitted. The small commission operating in Italy was augmented and a rehashing of processes and machine specifications was continued up into Germany, where the Commission, under the leadership of the Director, with some Italian advisers spent the first week in March, 1931 at the Leipzig Exhibition.

A new purchasing contract was then being negotiated between Germany and Russia, and in a short time the general decision had been made to divide the foreign productive equipment purchases among Italy, Germany, England, and United States. The commission was divided into two groups, one for England and America, headed by Director A. M. Bodrov, and the other for Italy and Germany, with a Mr. Kozicheff as chief.

Allotment of Machine Purchases to U. S., Italy, Germany, England

Among the groups competitive bids on all types of equipment were passed back and forth, by mail, cable and telephone. Finally, the bulk sum budgets for the various countries having been allowed, the buying plan was allotted about as follows: America—grinding machines only, with the exception of helical roll winders; Italy—electric furnaces, ball making equipment, some ring grinding equipment, roll lapping machines, and polishing machines, as well as some auxiliary equipment; England—grinding machines; Germany—forging equipment, automatic screw machines, chucking machines, presses, gaging and laboratory equipment. Deviations from this general decision were made only where material differences in prices, terms, or delivery developed, as they did in some instances. The conditions leading up to the moratorium affected the financial ability of some of the German firms to handle all the orders placed with or planned for them, so that some shifts were made, such as forging machine dies to Italy and gaging equipment to Russia.

Further Complications

In making the final detailed decisions as to what to buy and where to buy it, every effort was made to have the various bidders quote on similar equipment, without too much variation in processes. This was difficult because of the marginal capacities of different makes of machines, and meant that the final comparative charts were even more complicated than the American ones had been. Just before the moratorium was declared the director returned from America, greatly disgruntled because the orders were not being placed with greater dispatch in Europe. During a series of day and night conferences he endeavored to rush through these decisions before his impending return to Moscow. After the decisions were made and the orders issued to the Russian General Office for Trade in Germany, it was in some instances necessary to resubstantiate the decisions before a small commission headed by a representative of the general machinery buying office in Moscow, possibly because one of its branch offices in another country had protested that the best "buy" was offered there. In other instances, unsuccessful bidders demanded "defense" of the decisions, and these, though difficult, were rarely if ever refused.

Of course, due to the general buying contract then in effect between Russia and Germany, many German concerns had blanket contracts and other Russian commissions also had placed their requirements in some of these plants. However, in the summer of 1931, the Bearing Commission was the buyer of perhaps the largest groups of similar machines, and competition for that class of business was especially keen; 100 single-spindle chucking machines, 80 multiple-spindle chucking machines, 80 internal grinders, 120 oscillating grinders, 30 ball grinders—although not the exact figures—nevertheless give an idea of the size of some of the first releases. One finally successful bidder was fortunate in previously having made an arrangement to duplicate some patented American equipment, otherwise it would have been very doubtful if his largest bid could have been brought into the general competitive scheme on similarity of equipment.

Tool and repair shop equipment was not so restricted as to source of supply, equipment coming from nearly all the countries of Continental Europe, Russia itself supplying many lathes, some milling machines and some grinders.

One could not help but have the impression that Russia has the greatest confidence in American made machine tools, and would have preferred to buy mostly such. However, the ball equipment purchased in Italy could scarcely be duplicated anywhere for the processes employed. The German-built machine tools were constructed with an accuracy which the writer felt generally was equal to and in some cases better than American practice. There appeared to be, however, an appreciable discrepancy in the expected quality of the material used. When compared with American machines the heavier German equipment observed, (usually sold at considerably under American prices) seemed to lack much in design, material and workmanship. The English grinding equipment certainly was no improvement over the American and usually appeared to be designed less sturdily.

Vital Importance of Selecting Right Type of Demonstrator

One of the most important points to be observed in the fulfilling of an equipment contract made with the Soviets is the selection of the machine demonstrator to be sent to Russia to demonstrate the equipment and to instruct those appointed to learn from him. Unfortunately, some companies sent men equipped neither by physical condition nor inclination, to work contentedly amid the almost Spartan living conditions and in the severe Russian winters. Some arrived there, thinking pioneering is a de luxe travel tour, and could not believe other than that the Russians were taking advantage of them. One should learn early, to be content there, that the productive effort of the people which would be required to produce the comforts and conveniences of American life, is being expended to pay for foreign materials, equipment and services. The successful demonstrators do not become impatient under the duress of repeated necessity to reinstruct and to answer innumerable questions. Long hours mean nothing to them. They do not belittle Russian efforts to learn new mechanical operations. They know about everything there is to know about the machines they are demonstrating, technical, practical and theoretical. If the principals of such demonstrators have sent good equipment, they will accomplish better over-all results than their competitor with perhaps a better machine and poor demonstration.

(Third article of a series. The first and second articles appeared respectively in Vol. 77, No. 8, page 229, and No. 9, page 273.)

Choosing a Cutting Material

R. R. WEDDELL
O. K. Tool Company

TO SHOW readily the operating merits of popular metal-cutting materials, we have developed a pictorial diagram. This is an attempt to portray the relationship of the important features. No particular accuracy is claimed for the diagram, as it is impossible to measure definitely the desired characteristics under like conditions. However, as a comparative figure, to impress the user with the dominant features and limitations, it will prove handy.

A cutting tool is subject to three physical strains—pressure, abrasion and heat—which may be resisted in varying degrees by different cutting materials. The tool pressure is caused by the chip bearing down on the top of the tool. It may be lessened by increasing the rake angle or by introducing a lubricant to reduce the friction. Abrasion is caused by the action of the chip against the tool surface. This may also be lessened as above. Heat is produced in a tool by both of these physical actions. This may be reduced by the use of coolant. If the heat is excessive enough to soften the edge, rapid breakdown of the tool will occur. Unfortunately the property of a tool to resist abrasion varies inversely with its ability to stand tool pressures. That is, a tool that has great hardness is generally brittle.

Red hardness is a term signifying the hardness of a tool when operating at high temperature. The ordinary hardness of a cutting material is of no practical use unless its structure is capable of holding that hardness in some degree when in actual operation. Pressure and abrasion of the chip produce heat Sometimes the cutting edge of the tool is actually red hot. The uninitiated would think the edge would immediately fold over. But modern materials will hold the edge for some time under these conditions. The amount of heat developed at the cutting edge varies with the material being cut. Some materials, whose inner structure is rough and grainy, badly abrade the tool surface. Others that seem smooth, as fibrous materials, also quickly wear the edge away.

The intense pressure and abrasion on the tool impose shocks upon it. To resist these, the comparative toughness of the cutting tool material must be considered. Toughness is related to ductility; it is the opposite of brittleness. And the actual toughness of the material is not always the determining factor in this regard. The tool set-up, the section of the work being machined, whether it is thick or thin, and the tool support, all react on the tool. Cutting materials, that in themselves are of adequate toughness to be satisfactory are sometimes unsuitable because of practical operating conditions.

Our chart compares the general features of each of the popular types of metal-cutting material. It will be noted that as one gains in the property of red hardness toughness is sacrificed.

Carbon steel is the most ancient of our present cutting materials. It is useful for finishing cuts or for machining material that is quite soft. Woodworking tools are generally of carbon steel. Carbon steel is quite tough, more resilient than other cutting steels, but will not stand much heating of the cutting edge. It has been supplanted quite generally by high-speed steel for most metal-cutting tools, but for accurate form tools it is still quite popular, as it is claimed a smoother edge is obtainable with it.

High-speed steel is the most popular material used for metal-cutting tools today. It has application to most materials. It retains its hardness at a considerable heat. In fact, it has the best physical composite of all tools for metal working; hence its continued popularity.

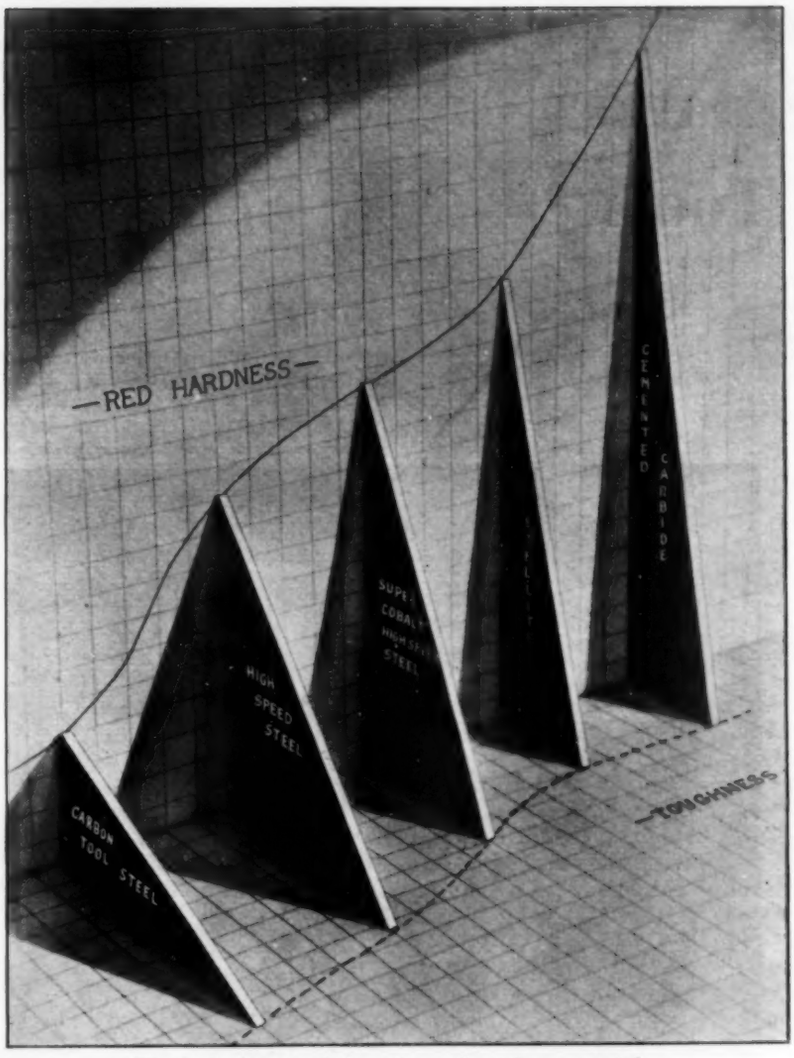
Super-cobalt high-speed steel is a further development of high-speed steel. Substantial addition of cobalt accentuates the power to resist wear. It also raises the temperature at which softening of the tool point begins. It is useful where the cuts are variable and the material is hard and scaly. Of all the new cutting materials recently brought forth this has made the greatest gains. It is a marked advance over ordinary high-speed steel in its desirable characteristics without losing too much of the vitally necessary toughness. Its greater cost may limit its application.

Stellite is enjoying a marked revival since the introduction of J-Stellite. It is fine for machining surfaces that are extremely hard, as cast iron of thin sections where the surface is chilled. It should be amply supported as the edge is more or less brittle.

Cemented carbide is the hardest cutting material known, closely approaching the diamond in this characteristic. Its extreme hardness proclaims its brittleness. Its high cost necessitates its use as a tipped cutting tool, the cemented carbide tip being brazed on. It is still in the development stage in the tantalum carbide grades which are useful on the most machined materials, as steel, heavy castings and forgings. Tungsten carbide has achieved marked success in cutting hard and abrasive materials such as thin cast iron and fiber. Its extreme hardness permits a much increased cutting speed to be used. A light feed is used, but the total metal removed is

Table of Cutting Speeds

Material Cut	H.S.S.	Super-Cobalt H.S.S.	J Stellite	Tungsten Carbide
Cast Iron	90	120	150	250
Steel Castings	75	100	x	x
Machine Steel	100	125	x	x
Alloy Steel	75	100	x	x
Bronze	100	125	150	250
Brass	250	300	400	500
Copper	250	300	400	500
Aluminum	800	1,000	1,000	1,500



Physical characteristics of metal-cutting materials

considerably more than with other cutting materials. Furthermore the edge holds much longer between grinds. It should be recommended after a thorough study shows that its cost is warranted, that the tool will perform under rigid cutting conditions, and that the machine tool can produce at the increased speed.

To sum up the application of each of these cutting materials, a table of cutting speeds used on various kinds of work is given above. Where no figure is shown, the metal can best be machined by those that are shown. But, to achieve these, operating conditions must be recognized, particularly in those materials that are capable of high cutting speeds.

From the foregoing it can be seen that no one material is a cureall. Each has a definite field of its own. Great progress is being made daily in metallurgical fields, but the application of these developments must meet practical considerations. Cutting materials must be considered in conjunction with the specific jobs they are to perform.

Bargain Hunting Customers

JOHN R. GODFREY

It began with a toll telephone call from a little town seventy miles away from the city. A power drive had broken down. Would they send a man out to look it over and give a price on repairs or on new parts? Having a reputation for rapid service and not being overburdened with orders, the sales manager himself went as the only man immediately available.

The small mill owner was pleased with the prompt response to his call, showed the breakdown and was given an estimate on the cost of repairs, under eighty dollars. But he couldn't place the order then; he had to get estimates from two other concerns also from the big city.

The sales manager was peeved, not because he didn't take the order back with him but on general principles. "I wonder, Mr. Franklin," he said in his smoothest voice, "if you've considered this job from all angles—yours and mine.

"You made three toll calls at say fifty cents each. Three concerns send men who each travel 140 miles at an actual car cost of over five cents a mile, or seven dollars each, twenty-one dollars for all three. And this doesn't count my time or that of the other men.

"In these days of close figuring on costs you can't expect over ten per cent difference in price between the three bids. And for a possible saving of less than eight dollars you make three companies spend twenty-one dollars for car use plus three men's time for a half day each, at least half the amount of the order spent in selling it to you.

"Don't you see that in order to break even all three companies must add this cost to the price of their product, even to those who don't ask them to drive 140 miles to get the order? You are making everything you buy cost you, as well as everyone else, more than it should. Just think it over before you spend money for your next toll calls. Pick a good concern, tell them what you need, and you'll get a fair price."

He got the order a week later. Mr. Franklin might have had his shop running again in two days if he hadn't had the bargain hunting spirit, and the other firms would have been money in pocket.

The Shop Free-Lance Discussion

W. R. NEEDHAM

John R. Godfrey's note (*AM*—Vol. 76, page 1236) is distinctly interesting. A former chief under whom the present writer once worked had the happy facility for getting excellent results from men of such ability as the man referred to in the case presented. One of these men had charge of the tool-room and of confidential processes. The trust placed in him was amply justified, alike as regards ability and loyalty. It is also good to realize that this man was then on the serious side of fifty.

Another man possesses a gift in the ordering and supervising of lifting operations. Whenever a job requires expert attention it is known that it is in good hands if he is in charge. He is much nearer seventy years young than sixty old.

Another friend was made drawing office free-lance to such good purpose that his constant watchfulness and initiative saved his firm hundreds a year. The company which possesses such a free-lance does well to give him rope enough and encouragement enough. There are men who possess a positive flair for putting things to rights and discovering means whereby the most disturbing and baffling problems are solved. Such men are to be found in most works. They should be given suitable scope.

Resistance Baths for Small Tools

A. E. BELLIS

President, Bellis Heat-Treating Company

DISTORTION, scaling, pitting, and variation in hardness are to be avoided in the heat-treatment of forming tools, thread chasers, and trimming dies. This is doubly important for tools that are not to be ground after heat-treatment. For tools that are ground the elimination of these evils will greatly reduce the finish grinding cost.

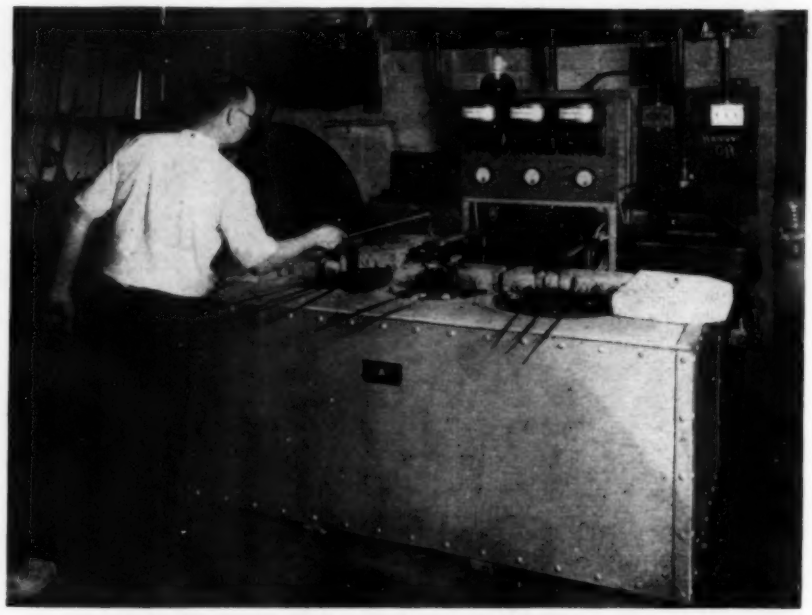
A solution to these difficulties was found by the National Acme Company in the use of immersion type resistance furnaces. On forming tools, for example, this method has eliminated one grinding which formerly cost a dollar per tool. Furnace installation cost was saved in three months on this item alone.

In addition, production was increased 50 per cent over previous methods of heat-treatment, and the life of the tools so treated was extended by about the same amount. In some instances tool life has been increased 300 or 400 per cent. This is because tools treated by the immersion method have tremendous advantage over those treated in an open fire if neither are subsequently ground. Many intricate forming tools are heat-treated without grinding afterward. If grinding is done after heat-treatment, there is then the advantage of freedom from excessive scale and more uniformity.

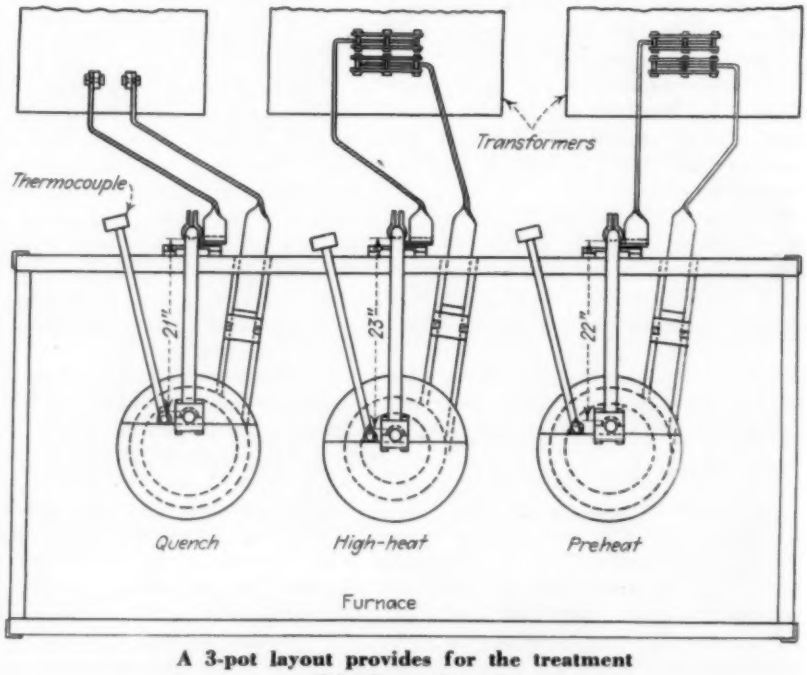
The liquid medium is heated by its resistance to the electrical current passing through it. Whereas the method of treating high-speed steel in a muffle or oven furnace requires heating to a temperature that sweats the steel, in the bath the surface is entirely protected. Careful regulation of the time and temperature to give a molecular structure corresponding to the best performance is possible.

Not only is injury to the surface avoided but distortion of the treated pieces is reduced to a minimum. Distortion, of course, is caused by heating or cooling one part of a piece faster than another. It is bound to occur to a greater or less degree in furnaces, in which the parts heat faster from conductivity where in contact with the hot floor than those portions subjected to radiation or convection from above. This lack of uniform heating and the resulting distortion cannot take place when the pieces to be treated are immersed in a bath.

This type of furnace is economical to operate. With the heat generated by the resistance of the bath to the flow of electrical current, there is the saving of not having to generate excessive heat outside the pot in order to bring its contents up to the desired temperature.



Heat-treatment by immersion in baths reduces scale and distortion, and lowers grinding costs



A 3-pot layout provides for the treatment of high-speed steel

There is no smoke, or other product of combustion, no dirt and no noise, with the result that the working conditions in the shop are much improved.

Heating the bath is accomplished by means of an electrode immersed in it and the passing of current from the electrode to the wall of the pot. There are no resistors to maintain, to heat up the room or to waste power. The pot is mounted in a heat insulated chamber as shown in the illustration. As the pot is protected from the atmosphere and as its temperature on the inside is no greater than that of the bath, its life is greatly prolonged. The average life of even a cast steel, high-heat pot, operating at 2,350 deg. F. is as much as eight days, and for lower temperatures, in some instances, almost indefinite. This of course is a great advantage over the type of furnace where the heat must travel through the pot wall causing comparatively rapid deterioration. The whole installation is extremely simple and inexpensive from the standpoint of first cost, maintenance and operation.

The electrical installation is shown in the diagram. Power is supplied at low voltage by means of a transformer. The value of the voltage applied depends on the size and type of pot. Automatic temperature control is secured by varying the primary voltage.

At the National Acme plant the furnaces used are of the triple unit type. Tools are first heated in a single-unit furnace operating at 1,400 deg. F. They are then run through the triple unit where there is a pot for preheating at 1,850 deg. F., one for the high heat of 2,325 to 2,375 deg. F., and a third for quenching at 1,100 deg. F. The high-heat transformer is rated at 30 kva., 440 to 14 volts. At full power input the current to the pot is 2,140 amp. and the supply current to the primary is 68 amp. The preheat transformer is rated at 25 kva. and the quench transformer at 15 kva. A unit if this size can harden as much as 200 lb. of high-speed steel per hour.

Annealing Stainless Iron

WILLIAM C. BETZ
Fafnir Bearing Company

In trying to form up a lot of stainless strip iron of the 18-chrome carbon type into retainer rings, we ran into a condition that caused them to crack, and as these pieces are worthless unless sound, we resorted to annealing.

The pieces were packed in containers with cast-iron chips, heated to 1,250 deg. F. and allowed to cool to atmospheric temperature in the containers. On removal they were found to be discolored to such an extent that they could not be used and to have lost their stainless qualities.

We tried to remove the film by tumbling in hardwood sawdust and by ball burnishing but to no avail. We finally pickled them in a solution of muriatic acid 20 deg. Be., 55 parts, nitric acid 42 deg. Be., 5 parts, and 40 parts of water. The solution is kept at 150 deg. F. The pieces were kept in the bath until all the stain disappeared.

After pickling, the parts were rinsed in running cold water and passivated in a solution of nitric acid containing 20 per cent actual HNO_3 at 150 deg. F. for thirty minutes; the parts were again rinsed in running water, then in clear hot water, and turned out into wire mesh baskets to dry.

If the work is not put through the passiviating process, it will not be stainless. The pickling process has a tendency to dull the finish of the metal somewhat so that it should not be left in the pickle longer than is necessary to remove the discoloration.

In annealing this material, it is better to heat in an open container without packing of any sort, cooling in the furnace and cleaning what film shows up in the aforementioned solution. This film will be easily removed.

Keeping Vertical Slides Lubricated—*Discussion*

ROLAND V. HUTCHINSON
Production Engineer,
General Aviation Manufacturing Corp.

At the end of an article under the title given above (*AM*—Vol. 76, page 1030), Francis W. Shaw says, "Personally, I should like to see a discussion on this, by no means simple question."

There are several solutions to Mr. Shaw's problem. Here in the United States there are at least three sources of what may be termed sintered bushings. The bushings are impregnated with hot oil, taking up about 25 per cent by volume, and later are run through a sizing die to hold the inside and outside diameters.

These bushings are not oil-less, but come equipped with an initial oil supply, which must be replenished from time to time. The bronze matrix is very hard, and the bushings should not be reamed for the two following reasons: (*a*) The pores on the bearing surface tend to close under the cutting action of the reamer, and (*b*) the reamer does not cut such hard material easily and loses its edge. These two objections are overcome by making an installing mandrel for fitting the bushings. The mandrel should be shouldered and should have a pilot slightly larger than the shaft that is to run in the bushing. The bushing and the mandrel are driven into the hole together and then the mandrel is backed out, leaving the bushing in place.

The oil supply is fed to the back part of the bushing, which is not drilled, but which because of its porosity becomes damp throughout and thus is self-distributing of lubricant.

For use with high-speed shafting having single-directional rotation, I use a slinger cellar below the bearing to act as a drip preventer, provided the oil is not too viscous to be thrown off of the ring. The supply recommended is a full-length felt pad located on the low pressure side of the bearing, and the rate of feed regulated either by adjustment of the gravity head of oil on the felt, or by changing the texture of the felt. For cleanliness, the cavity inclosing the slinger must be of ample size and its drainage must be adequate. Where continual supply of lubricant is assured, particularly before starting, a helical groove of the proper hand cut along the bearing will lift up the oil to the upper end of the bearing. If the oil supply fails, this arrangement still works as a viscosity pump and pumps the bearing dry. The edges of such a groove must be sharp and act as scrapers.

Most of the trouble with vertical bearings is on starting after a shut-down, and provision should always be made to minimize end leakage, or else to provide ample reservoir capacity within the bearing itself. Where bearings are split, there should either be no shims or the shims should be faced with babbitt or other soft metal. Pinching of the liners onto the shaft at the split may be minimized by making them with "combed" or interrupted relief, so as to give the liner metal space to flow laterally instead of causing a seized bearing; then no axial path for leakage of oil is provided. The sintered-metal bushings and the felt pads provide oil reservoirs at the bearing surface.

After shut-downs of any extent, the whole lubricating system should be checked over, and where reliability is paramount, the oil supply should precede the starting of the machine proper. One way is to provide pressure feed driven by a separate motor having a pressure-controlled interlock, such control beign located past the bearing that is most remote from the pump.

New Methods Cut Bus Maintenance

AN INTERVIEW WITH

W. J. CUMMING
General Superintendent, Surface Transportation Company

IN MAINTENANCE as in medicine, prevention is the ideal toward which we strive. But usually the breakdowns and the ills of daily operation consume so much attention that tomorrow's troubles are neglected until they are upon us. Then they often turn out to be duplications of those that plagued us yesterday.

It is refreshing, therefore, to see a real job of preventive maintenance being done by the Surface Transportation Company, which operates a fleet of 224 vehicles over 136 miles of bus routes in the Borough of Bronx, New York, and in Yonkers and White Plains. In its quest for the avoidance of recurring causes of maintenance, the shop of this company has explored the possibilities of new methods and materials. It has no separate experimental laboratory to lean upon but uses its daily tasks to conduct a continued series of experiments through which it has achieved greater standardization, prolonged the life of operating equipment and reduced costs.

Without making any attempt to cover the wide variety of jobs performed, the following description gives a few examples to illustrate the end toward which this shop is aiming and its way of approaching it.

Such parts as connecting rods, crankshafts, steering knuckles and other important members were often found to fail in the same way. Because of a belief that changes in design might correct many of these repetitions, a magnetic inspection device was installed to detect the nature and location of defects. The apparatus consists of a 550-volt electromagnet above which parts are placed in such a position that the lines of magnetic flux pass through them. The parts are then sprinkled with DeForest Magnoflux, a fine powder of low-carbon iron which patterns itself according to the lines of magnetic force. A crack in the part tested interrupts the flux lines and becomes clearly visible from the concentration of powder at that point.

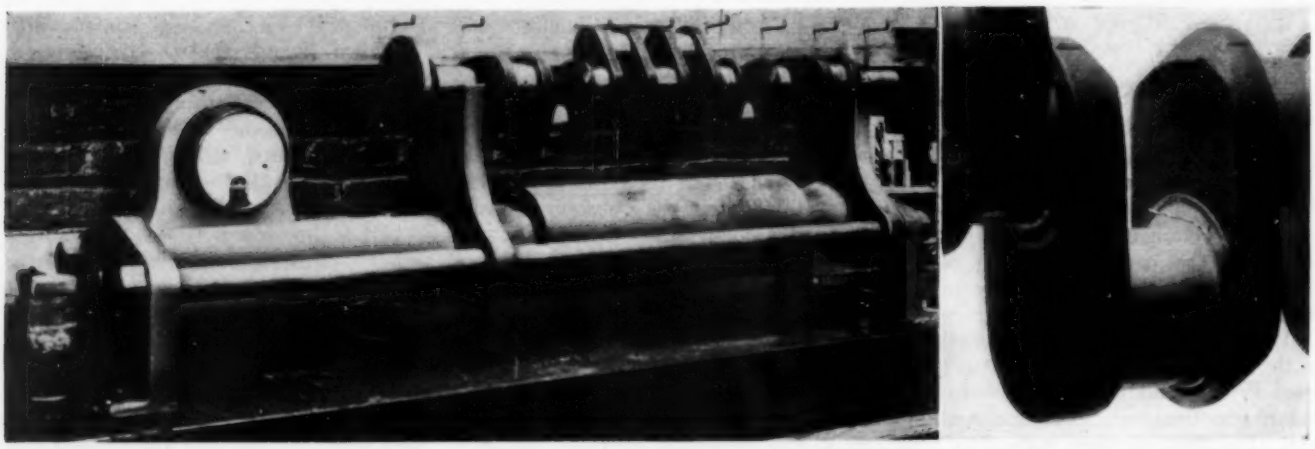
While magnetic inspection in itself is not novel, its application to maintenance work is uncommon. In this instance, it has fully justified its use. Some of the troubles were found to be based on familiar defects in design such as sharp corners or too small fillets on crankshafts, steering knuckles and other important members. Saw slots in the split upper bearings of connecting rods gave trouble, often causing a crack in the web running lengthwise. Even the manufacturer's name and part numbers stamped on drop forgings have been found to act as the source of cracks.

Magnetic inspection serves two purposes: the specification of improved designs on purchased replacement parts and on new motors; and the use of preventative operations on parts when the engine chassis is overhauled. Small fillets are enlarged even though this often means facing an adjacent surface and using a thrust washer. Holes are drilled at the end of saw cuts in connecting rods to eliminate sharp corners. Rough surfaces of castings and forgings are draw-filed to remove incipient sources of cracks.

Welding plays an important part and is a subject of continued test. One motor is being put into service with each exhaust valve seat repaired by welding with a different material. Gas and arc welding are both employed.

Worn valves are salvaged by welding with Stellite which, it is claimed, makes them better than new. Large castings, such as motor blocks, are placed in a furnace which preheats them prior to major welding operations, preventing excessive strains caused by localized heating.

For salvaging worn shafts the metal spray process has proven effective. A Metalayer gun has been mounted on the



Left—Magnetic testing shows the location of flaws in a crankshaft. Right—Powdered flux betrays a crack in the fillet

Valves are salvaged by welding with Stellite

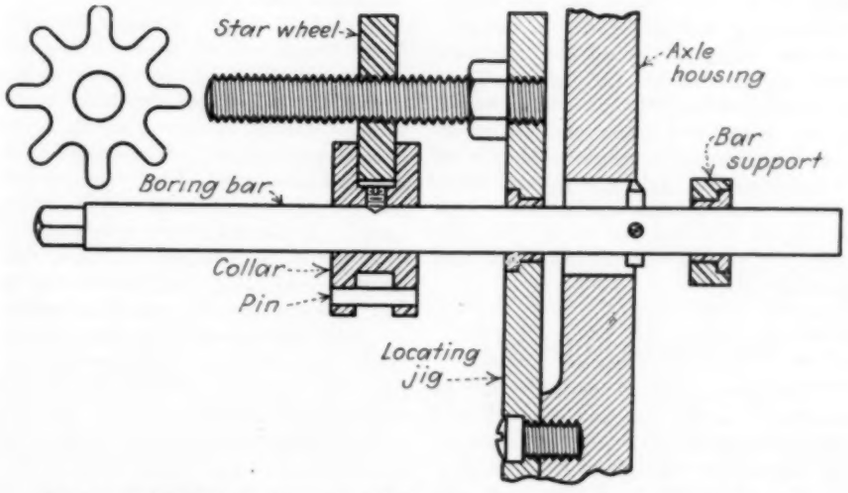
carriage of a small lathe geared so a metal thickness of about 0.020 in. is deposited by each pass.

About 0.60 in. is considered a satisfactory coating, thinner layers having a tendency to scale off. Prior to spraying the surface of the work is roughened under a steel pellet blast using a Pangborn machine. The metal coating is formed from an 0.85 carbon steel rod fed by means of a small air turbine within the gear. Oxygen and acetylene fuse the metal.

Pumps, shafts, crankshafts, camshafts and many other parts are built up in this way. Of course, grinding must follow these and most welding operations. One of the advantages is the restoration of the part to its original dimensions, making possible the retention of standard bearing sizes.

Metal sprayed parts examined to date have given good service but have not been subjected to enough mileage for conclusive results.

Ingenuity is displayed in making repairs with the least amount of disassembly time. This often means the use of special tools, most of which are designed and made in the company's own machine shop. An example is a self-feeding hand-operated boring bar for refinishing brake operating rod holes and anchor stud holes. This bar is illustrated in the accompanying sketch and employs the familiar star-feed principle. A locating jig and a supporting bracket are bolted to the axle housing to hold the bar at either side of the hole to be bored. Fitted to the jig is a fine threaded stud. A special collar on the boring bar straddles the star wheel which is tapped to fit the threaded stud. A pin through the collar strikes the star wheel at each revolution of the bar, causing the wheel to advance and carry the boring bar with it.



Brake anchor stud and cam rod holes are rebored with a homemade tool

An example of the use of new materials lies in the current experiments with the nitrided chrome-vanadium steel pins which are used in Stellite piston bushings. Nitrided chrome-vanadium crankshafts are also under test. Carbide cutting tools find a place in the machine shop and are used on the more difficult jobs.

Savings through the adoption of new ideas go far beyond reduction in maintenance operation itself. Road service failures are costly and have been reduced to a minimum by systematic periodic inspection. The failure of one part may cause damage far beyond its own value as, for instance, the breakage of a connecting rod which destroys the motor block.

The justification for the company's progressive mechanical policy may be found in its profit and loss statements over the last three years. During the fiscal year, which ended June 30, 1929, there was an operating deficit of $228,672. This was reduced to $36,059 in the following fiscal year. In 1931, the company showed an operating profit, for the first time, amounting to $316,689. For 1932, despite generally bad business conditions, the profit was increased to $326,529. No further proof is needed to demonstrate that antiquated methods do not pay.

Boring and Grinding at One Setting—*Discussion*

A. RAYMOND
London, England

Referring to the article by Francis A. Westbrook under the title given above (*AM*—Vol. 77, page 11), we used a similar set-up some time ago.

When tungsten-carbide tools were introduced, the grinding head was discarded and a stout toolholder fitted with a tungsten-carbide toolbit was used in its place. It gave good results without giving rise to that uncomfortable feeling that, despite careful guarding, some of the wheel grit was going to get where it was not wanted.

Testing Low-Pressure Gages

FELIX J. KOCH

The chief engineer of a residential community had from time to time to test the gages of the low-pressure heating plant. He plugged one end of a 1¼-in. pipe about 12 ft. long, and drilled and tapped a hole near the plugged end for the connection of the gage to be tested. He also drilled and tapped five other holes, into which he screwed pet cocks. One hole was 11.53 ft. from the hole in which the gage connection was screwed and the other four holes were equally spaced between the two.

With the gage screwed into the connection and the pipe stood on end and filled with water, the top pet cock was opened, allowing the water above it to drain out. The gage should then register 5 lb. Opening the next pet cock below and letting the water above it drain out, the gage should register 4 lb. Opening the other pet cocks in turn, the gage should register 3, 2 and 1 lb. respectively. If the gage did not register correctly when the several pet cocks were opened, adjustment was made by shifting the position of the gage hand in the usual way.

Heat-Treatment of Gearing

E. F. DAVIS
Metallurgist, Warner Gear Company

When confronted with noisy gears, the gear cutter's invariable explanation is, "They distorted in the fire." This is no myth—everything in hardening favors distortion. But there are other myths of long standing in hardening practice which the author ably dispels.

WHEN we apply the term "heat-treatment," we usually refer to the operations of carburizing, hardening and tempering after the parts are machined. However, heat-treatment of gears really begins from the time the scrap, lime and ore are dumped into the open-hearth or electric furnace and continues through all the subsequent metallurgical processes of casting, ingot heating and rolling, billet heating, and so on through forging, normalizing and annealing. All of these are heat-treating operations, and all have an effect on the finished gear.

It is, therefore, essential that we regard mill heat-treatments as important as those performed in the plant of the gear maker. To regard merely the final hardening and tempering as representing heat-treatment is like reading the last chapter of a book without any knowledge of what has transpired in the previous chapters. Nevertheless, to treat all of these metallurgical operations is beyond the scope of one paper. Hence, we will assume that the steel as delivered from the mill is of good uniform quality, satisfactory for gear purposes, and confine our attention to those metallurgical operations exterior to steel practice.

Gear teeth are subject to fatigue and impact strains, and the resistance to these stresses is greater at right angles to the fiber than parallel to it. A gear made of bar stock does not have the impact or fatigue value of an upset gear. A series of idler gears made of bar stock were examined for impact in our laboratory in comparison with a similar number of upset idler gears of the same kind. The material was SAE 5150 chrome steel. The oil-hardened gears averaged 30 ft.-lb. impact while the same gears of upset stock averaged 55 ft.-lb.

Many years ago the Willys Overland Company experienced some unexpected breakage on their rear axle pinion on their Model 90. The pinion was highly stressed but the model was in big production, and redesigning the rear axle was impractical at the time. Their metallurgist changed from a drop forged pinion to an upset pinion and the breakage immediately stopped. The act of distributing the grain was all the difference between success and failure. It is estimated that steel is fifteen per cent stronger in shear across the fiber than parallel to it.

Real Forging Required

The temperature of forging is not as important as the amount of work and the finishing temperature. Steel should be forged high enough to be fully plastic in order to fill out the dies and make sharp cornered forgings. It is obvious that large forgings, such as crankshafts, must be heated hotter than an idler gear forging. The finishing temperatures should be about 1,700 deg. F. If we heat a piece of steel to 2,300 deg. F., the grain grows by prolonged heating to enormous grain size. If the steel is subsequently worked, then the grain is reduced again, and no harm is done. If it is not worked to any extent, then the grain size remains large, and the steel is weakened in a corresponding degree.

There is a lot of difference between pecking at a piece of steel with a light hammer and forging with a heavy steam hammer press. Using hammers which are too light does not give the grain the fine desirable density but instead varying grain size which is often a cause of gear distortion. Good working of steel improves the machinability and betters hardening properties. A gear made of bar stock never hardens as well as one made of a forging.

After the forging operation, gear forgings should be normalized. Gears annealed, but not normalized, always show more movement in the final hardening operation than gears which are both normalized and annealed. In fact, all our researches into the cause of gear distortion have shown that lack of correct normalizing is one of the principal causes of gear noise. Normalizing is conducted at temperatures from 1,700 to 1,850 deg. F. and consists of bringing the gears up to temperature, holding for one to two hours at heat and then cooling at a fairly fast rate to prevent abnormal grain growth.

Annealing is a separate operation from normalizing. It consists not merely of softening the steel so it can be machined but is a highly developed metallurgical science, involving all the available knowledge of micro-constituents and metallography. Each type of steel must be annealed to some definite micro-pattern if the maximum machining results are to be obtained. Thus an SAE 6150 or SAE 5150 steel would machine best with a lamellar pearlitic pattern. An SAE 2345 must be slightly sorbitic. SAE 4640 will not form lamellar pearlite and will be spheroidized pearlite with a blocky ferrite.

A structure suitable for gears generated in a Fellows machine may not be the best for a hobbed gear, and the structure suitable for a spur gear may not be the best adapted for a helical gear. We make cluster gears having both helical and spur gears on one forged unit. Our gear department claims that, when the spur gears are somewhat rough, the helical gears are the smoothest, and when the spur gears are smooth, the helical gears do not have a desirable finish.

In determining the correct annealing structure, blanking, drilling and broaching must be subordinate to gear cutting but, of course, these production operations must not be difficult to perform either. However, variations in the rake and clearance are easily made with any tool but the gear cutter which, being an accurately formed tool, cannot be

Presented before the annual meeting of the American Gear Manufacturers' Association, Wilkinsburg, Pa., May 5, 1933.

changed in clearance and only a few degrees in the angularity of the rake, for if it is changed too much it will not generate good involutes. When we consider that in gear cutting the tolerance in tooth form variables is seldom over 0.0008 in. error, it may readily be understood that we can do little with cutter corrections.

Carburizing

The carburizing operation consists of impregnating the surface of the steel with carbon for which it was an affinity when the steel is heated. The depth of this penetration will vary from $\frac{1}{64}$ to $\frac{1}{8}$ in., depending on the time and temperature at the carburizing heat which is usually within the range of 1,650 to 1,750 deg. F. At a certain temperature and a definite time, the carburizing penetration should proceed at a fairly uniform rate. If it does not, we regard the steel as abnormal. Abnormal steels are oxidized steels. Hence, we assume that the carburizing gases, which are usually carbon monoxide, are unbalanced by the necessity of attacking the oxygen first, removing it and thus upsetting the chemical equilibrium. We thus have a peculiar crowding of carbide in the outer zone and a distorted cementite. We may compare it to the damming of a river with ice, for the oxygen prevents the normal flow of carburizing gas.

Although we associate pack hardening with solid carburizing, the actual phenomena is chemical and is done with a carbon bearing gas. Some types depend on the dripping of hydrocarbon liquids such as aniline. The continuous types utilize methane, propane or butane mixed in the correct ratio with flue gas or CO_2.

There is seldom any change in a gear during the carburizing operation providing the temperatures are held fairly uniform and the steel has been correctly normalized. However, in stationary furnace practice, it is impossible to obtain uniform heating rate and uniform temperatures in the various boxes in one furnace. The author made a test some years ago in a Tate-Jones carburizing furnace loaded with eight boxes of work. A thermocouple was placed in each box, and in addition, the regular furnace thermocouple was used as a check against the interior temperature. It was found that variables as high as 410 deg. F. were obtained during the early part of the heating period, and as high as 120 deg. F. at the termination of the carburizing cycle. In fact, one of the eight boxes exceeded the temperature of the furnace reading by 35 deg. F., this probably caused by internal combustion. This condition was recognized a number of years ago by metallurgists, and box furnace practice is now practically obsolete except in small gear plants whose production does not warrant the use of continuous furnaces.

The continuous furnaces used in gear carburizing are the rotary type, the straight through tunnel type, the counterflow and the return counterflow sometimes called the boomerang furnace because the work comes out the same door it enters. This latter type of furnace will carburize at a cost of less than one cent per lb. The gas continuous furnaces will, no doubt, supplant these furnaces for these will carburize at a cost approximating 5 mills. The chief factor in this cost reduction is the elimination of carburizing boxes and compound. Variables within 0.010 in. in case depth do not seemingly affect distortion. Sometimes results in the shop indicate that these variations are factors in distortion, but research does not indicate that it is important.

The operation of hardening a gear always produces internal changes in the steel. Metamorphism from pearlite to martensite is accompanied by a change in volume. The surface of the metal is subject to oxidation and corrosion by furnace gases. They are expanded when they are being heated and contracted when they are quenched. The thin sections will cool first, thus producing strains which will cause warping.

Oil-Hardened Gears Expand

The oil-hardened gears almost invariably expand permanently in hardening, and this, of course, increases the diameter of the pitch circle. This increase usually approximates 0.001 in. per in. of diameter. Thus twelve gears measuring 3.773 in. in diameter expanded on the pitch diameter an average of 0.0033 in. Twelve gears measuring 6.472 in. expanded an average of 0.0055 in., and a third lot of gears measuring 2.917 in. expanded 0.0024 in. average. This expansion is not always uniform. Design and hardening temperature are also factors. Thus if the gear were a thin ring, it might not expand but actually shrink. The permanent expansion also increases with the corresponding increase in hardening temperature. Thus a 0.40 carbon chrome steel, hardened in cyanide, showed the following permanent increase in diameter at different hardening temperatures. This gear measured 3.553 in. on the pitch line.

Hardening temp. F.	Increase in diameter
1400	0.0022 in.
1480	0.0025
1500	0.0031
1525	0.0037
1550	0.004

The rule of 0.001 in. per in. of diameter is generally true and is used by us in maintaining our backlash within the close requirements demanded by some of our customers.

As a general thing, the lower the hardening temperature the less will be the distortion. On the other hand, the type of steel employed is a factor. The fine-grained electric furnace steels, such as the nickel and chrome-nickel-molybdenums, have been quenched directly from the carburizing boxes and have shown excellent results in several plants. Our results with this method have not been as gratifying as we anticipated. Nevertheless, it is a fact that these fine-grained steels do not change as much in heat-treatment as many of the coarser grained varieties.

Quiet Gears

When carburized gears are hardened, the movement is toward the hole. Hence, we generally term this as shrinkage. The periphery under good hardening practice changes very little. Hence, it would seem that there are greater possibilities for quiet gears from the low carbon steels than with the oil-hardened type—and to a great extent this is true. The carburized gear got a black eye when gear cutting methods and machines did not have the present accuracy. Carburizing was a crude process, normalizing was not practiced, steels were of poor quality, and steel metallurgy was in its infancy. We manufacture both carburizing and oil-hardening gear steels, and in looking over our rejection records for a year, I fail to see any difference between the two. The carburized gears, incidentally, are used in passenger cars of the higher class where the standards for quietness are more severe.

The rate of quenching is one of the most important factors in gear distortion. For example, if we quench gears in water, we would expect them to be noisy, and for that reason, water quenching is avoided whenever possible. Yet oil, although milder in quenching effect, may be too severe for gears with fine pitch teeth or thin sections. The oil quench may be modified by heating the oil and by avoiding agitation of the parts in the quenching bath. Quenching conditions must be adjusted to the mass to be hardened, and the cooling rate should not be excessively fast but sufficiently rapid to maintain the desired hardness.

Each time a gear is retreated, the amount of distortion increases. The maximum change occurs in the first treatment, but every subsequent rehardening and quench increases the involute error and the growth of the steel.

We retreated a number of gears rejected by our metallurgical inspection and found that these gears showed much higher rejections on the test stand than standard production. It was formerly the practice to double heat-treat carburized gears. This is one of the explanations for noisy carburized gears and has been largely abandoned by gear hardening plants.

Furnace Shortcomings

The old type square furnace has hardened many gears and was used for a number of years in the earlier days of the gear industry. It was difficult to harden gears uniformly in it, as the gears scaled excessively. It is seldom used at present except in small job shops. The stationary electric furnace gave less scale and hardened more uniformly but had the bad habit of decarburizing the surface. It was also expensive to operate. The rotary electric was not a success because of the hard tenacious scale produced. One firm was compelled to copper plate all their gears hardened in this type of furnace. Rotary, gas and oil furnaces were more successful, are still being used by many companies for hardening both differential and transmission gearing and do not have the faults of the electric type. The electric tunnel type being open at both ends also does not have the bad atmospheric conditions of the stagnant rotary and stationary electric types. The Hump furnace gave early promise of an ideal method for heating gears because of their small capacity; the graphic record of each nest of gears heat-treated showing the thermo-critical phenomena was alluring. But it was found that these furnaces did not heat uniformly from top to bottom; variables as much as 80 deg. F. were found. These furnaces also decarburized at times and occasionally pitted the tooth surfaces.

The lead pot has been a favorite method for heat-treating gears and is still in use in several plants. The chief objection to this method of hardening is the adherence of the lead to the parts and the inability to control the temperature because of its high heat conduction.

The cyanide method of hardening is at present the most popular, not only on account of the method itself but because of the useful properties imparted to the surface of the gear. Probably 75 per cent of the gears produced are now being hardened in a cyanide bath.

There are several ways of performing this operation. One is by preheating the gears in a rotary or Hump furnace and then giving the gears an immersion for about 1½ min. in cyanide; another is by direct immersion in a stationary furnace; and the third is by the continuous cyanide furnace. The cyanide method is of sufficient importance that some of its metallurgical features will be discussed.

Many gear makers still hold a prejudice against dipping a cold gear into a molten bath believing that this act produces distortion. There is a fostered belief that, unless steel is heated slowly and carefully, it will warp, and to take a cold gear and plunge it into a molten mass of salt is violating all the principles of good heat-treating practice. They prefer to preheat the gear and merely to dip it into the cyanide after it has had the slow and careful treatment. This is the so-called cyanide dip method. When such a gear is first placed in the cyanide bath a more or less violent reaction occurs caused by the cyanide attacking the oxide of iron on the gear surface, for cyanide is a solvent for oxides. In about a minute, this reaction subsides and the gear may then be removed and quenched. Quite a bit of cyanide adheres to the surface; hence the take-out loss is high. For that reason the cheaper grades of cyanide such as the 45 per cent should be employed. The cyanide dipped job is not file hard, and the case is comparatively low in nitrogen.

The direct cyanided gear is immersed in the cyanide bath without any previous preheat except drying, and is brought up to temperature in the cyanide itself. After a definite period, which seldom exceeds an hour, it is removed from the bath and quenched.

Continuous Cyaniding

In the continuous type, the work is carried through the bath by means of a conveying mechanism exterior to the bath itself. This latter type of furnace may be automatically controlled within 20 deg. F. because at no time is any heavy mass of metal added to the bath. The pots used are of necessity large. We employ the screw type conveyor. The Buick furnace has a rotary mechanism and is circular and of a doughnut shape. These furnaces are practical only for firms having considerable production. Another advantage of the continuous type is that the time in the cyanide furnace is regulated mechanically by the conveying system, and the human element is removed.

Anyone contemplating cyaniding should not forget to use a lower carbon steel than would be necessary for the furnace treated oil-hardening grades. Thus a 0.50 chrome steel would be too brittle when cyanided. A 0.40 carbon-chrome steel when cyanided would have the same impact values as a 0.50 carbon-chrome steel. The cyanide process should be regarded as a semi-nitriding process for nitrides as well as carbides constitute the case.

The latest modification of the cyanide process is the energized bath of which the aero case method is representative. This produces a case similar to cyanide but is somewhat higher in carbides and lower in nitrides. In this type of bath, a neutral salt melting at about 950 deg. F. is used. To this is added various activating agents of which calcium cyanide is typical. Some objection to the use of calcium cyanide is its decomposition into lime which is difficult to wash from the surface.

Wearing Qualities of Case

The advantage of the cyanide case is its excellent wearing qualities. On our dynamometer tests we have found the cyanide case to be the best wearing of any kind of tooth surface. Taking the furnace-hardened gear steel of 0.50 carbon as a unit, our dynamometer results indicate the cyanide dipped case will give four times the wearing life of the furnace hardened, the carburized surface eight times the oil-hardening furnace-treated steel, and the cyanided surface shows eleven times the wear of the furnace hardened gear. It will be noted that the cyanided gear wears even better than the carburized gear. This is caused by the extremely hard nitrides of the cyanided case. The extreme outer layers for a depth of 0.0005 in. will show a nitrogen content up to fourteen per cent. Although the preceding results are based on the time required for overloaded gear teeth to show pitting, yet in actual field results a worn or pitted gear is rare.

Another myth, I would like to explode at this time, is that the process of cyaniding makes noisy gears. Bad tooth form is the chief cause for noisy gears. It has often been assumed that cyanided gears had a higher pitched tone, but after observing one transmission model in production for three years, with rejections not over one per cent, I can see no basis for the assumption that the operation of cyaniding has any influence on the acoustics of transmission gearing.

Since we have adopted the cyanide process, not only has the wearing qualities of our gears improved but the breakage has decreased. We have found that worn gears do not last long after the tooth form is destroyed by wear and pitting, and that such gears fail quickly from fatigue. If the involute is maintained better gear life can be expected. It seems, therefore, that the slogan of the paint manufacturer also applies to gearing "Save the surface and you save all."

EDITORIALS

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Industrial Revolution—1933 Model

Rugged individualism, prized possession of the pioneers who built infant American industries into the giants of 1929, has lost its hold on industrial and business leaders of 1933. After all, as one president puts it, why should we keep on running after we have caught the train? A homely way of saying that mankind has struggled for thousands of years to overcome the scarcity of food and other needs, and having succeeded, must needs keep on struggling from force of habit.

The change of heart evidenced by the leaders of industry may truly be termed revolutionary. When Gerard Swope first presented his plan for reasonable control of industry two years ago he found few to go along with him. Last week he must have had considerable satisfaction in watching the convention of the Chamber of Commerce of the United States turned into a forum to discuss ways and means of putting much the same ideas into workable form.

When the Black bill for a thirty-hour week and other limitations on business slipped through the Senate, Washington looked for a howl of protest from industry. There were vehement objections, it is true, but they were raised against the impractical features of a hurriedly drawn bill rather than against the principle involved.

Editors of *American Machinist*, in their talks with executives, big and little, in the metal-working industry, have been amazed at the change in point of view expressed in serious conversations. Not a few of these men have said frankly that they expected a strong swing from individualism toward collectivism, and that they saw no hope for American business in any other direction. This is a revolution of real significance.

Most of the men who are now asking the government to help them in overcoming evils with which they have found themselves unable to cope are either ignorant of the extent to which government control may affect individual plants or whole industries, or else they are giving it no thought. Of the few who foresee the changes that are coming the majority are willing to accept them as unavoidable, and more than compensated for by the benefits to be obtained.

The President, in his short address to the members of the Chamber, put it squarely up to business to cooperate in finding a way to revive activity and to eliminate obstructions. Here is an opportunity for constructive thinking unparalleled in recent business history. Will business leaders and the trade associations rise to it?

They must, or Congress will do it for them. Hearings on the Perkins substitute for the thirty-hour bill passed by the Senate have been going on as fast as possible before a House committee. Meanwhile, other substitutes are in process of formation, in the hope that something acceptable, workable and sensible can be found and enacted before the special session is adjourned.

As this is written, the general belief is that industrial control will be secured through strong trade associations, guided in turn by a national commission or board to protect the public interest, should that need protection, and to coordinate the plans of various industries.

In view of all these indications there can be no doubt that an industrial revolution is in progress. The part of wise men is to do their utmost to guide it into safe channels, to the end that its outcome may help as many of us as possible, and harm as few.

Double-Edged Price Cutting

So long as price cutting operates in only one direction, against the price cutter's competitors, it looks like a most effective weapon. But today the wielder of this weapon is finding it harder and harder to keep it from developing boomerang attributes. It is showing a fiendish ability to injure him as much as it does his victims.

Now that the banker has such a keen interest in the success of industrial enterprises in which he has unwillingly become involved, a new restraining force can act on the price cutter. Within the week a notorious price cutter has been refused a sorely needed loan from his bank on the ground that operating at a loss is bad business, now or at any other time.

Price cutting, damaging under any conditions, is doubly dangerous today.

Make a Profit or Quit

Recent proposed legislation giving trade associations real power instead of hampering their activities may have a far reaching effect on business. The one fundamental that should help in all lines of industry is that of penalizing any company that does not operate at a profit.

Our capitalist society is based on profit. And while too much profit is undesirable, no profit or a loss is suicidal. If no company was permitted to do business

at a loss, cut-throat competition would disappear and healthy competition would have its opportunity. The working of such a plan would require standardized accounting and would largely eliminate the secrecy as to finances that now exists. But business should be more healthy if only such concerns as could show a profit were permitted to stay in the picture.

• CHIPS •

President Roosevelt makes second radio progress report to the country . . . Explains intention to restore relative values existing at time most of current debts were incurred . . . Expects to control inflation beyond that point to avoid danger of permitting debts to be cleared off with dollars worth less than at time of incurring . . . Expresses determination to help industry to prevent over-production, eliminate cut-throat price competition, control hours of labor and wages . . . Outlines plans for mortgage relief, direct relief to states for emergency cases, public works program . . . Emphasizes conviction that although a certain measure of prosperity is possible in the United States alone full prosperity can only come in a world of prosperous nations . . . Says that aims of economic conference are reduction of armaments and armament costs, cutting down of trade barriers, stabilization of currencies, re-establishment of confidence and friendly relations.

Farm bill including inflation amendments passes both branches of Congress and goes to conference . . . State unemployment relief bill passes . . . So does Muscle Shoals bill . . . Roosevelt recommends emergency program for railroad legislation including repeal of recapture clause, subjection of holding companies to I.C.C. regulation, appointment of Federal co-ordinator of transportation . . . Cummings threatens gold-hoarders with publicity . . . Business leaders rally to support of plan to employ government agencies in helping to promote constructive, cut out destructive forces . . . Hearings on Perkins bill show industry favoring minimum wage, organized labor opposing.

Date of London economic conference set for June 12 . . . Japan withdraws army from North China . . . Seldte, leader of German Stahlhelm party, goes over to Hitler dashing monarchist hopes . . . Hitler establishes Prussian model of Soviets' OGPU to stamp out communism . . . British leaders negotiate trade agreements with Denmark, Argentina and Germany . . . President Cerro of Peru assassinated . . . Succeeded by Gen Benavides . . . Venezuela out of debt and possessor of a treasury reserve . . . Geneva rules German police part of army, Brown Shirts not . . . Nazis take over German labor unions, organize industry on Italian plan to eliminate competition . . . British House of Commons votes doubling of pound stabilization fund to offset effect of dollar deflation on export trade.

England and France unite to maintain status of their respective currencies . . . Stock exchange moves to force Allied Chemical and Dye to stop issuing "misleading financial information" . . . Three-day run on Cleveland Trust, attributed to malicious rumor campaign, halted by announcement that U. S. is backing licensed banks to the limit . . . Stock average rose over forty-five per cent in April . . . Hoarders defy government order to relinquish gold . . . Brokers' loans reach high mark for year . . . Dollar drops to unprecedented lows on foreign exchanges, lower even than expected here . . . European bankers, disillusioned by recent inflation experiences, take gloomy view of U. S. inflation moves . . . London, ignoring our domestic problems, scores abandonment of gold clause.

Secretary Perkins plans to substitute co-ordination of local employment activities for former federal system . . . Plymouth recalls 3,000 to handle orders for new models . . . 6,000 will be kept busy during May . . . Laughlin plant of American Sheet and Tin Plate at Martin's Ferry resumes with 1,500 men . . . American Radiator and Standard Sanitary plant at Louisville adds 1,200 more men, plant at Trenton, 400 more . . . April automobile production up 62 per cent over March, 3 per cent over April, 1932 . . . Goodyear recalls 150 former office employees in extension of 7-hour, 5-day week plan.

Kent reports steps taken to increase business with South American countries . . . German, Italian, Mexcian and Argentinian representatives come to Washington to discuss trade agreements . . . Twentieth Century Fund issues report setting debts of nation at forty per cent of wealth, carrying charges at twenty per cent . . . Detroit buying wave following release of bank funds catches merchants unprepared . . . Manchukuo imports from U. S., mostly iron, steel and machinery, increase sharply . . . Goodrich leads the way by advancing tire prices . . . Commodity index up 4.15 per cent in April . . . State Department agrees to inclusion of Soviet delegates at wheat parley . . . Farm radicals vote food strike for May 13.

Steel ingot production tops 30 per cent of capacity . . . Better than any month since November, 1931 . . . Scrap prices rise strongly . . . Copper rise followed by increases in prices of sheet copper and brass . . . Stock market continues strong with volume heavy . . . Wheat, cotton and other commodities rise in expectation of strong inflationary movements . . . Electric power output approaches within 2 per cent of corresponding week in 1932 . . . Index of building material costs up four points.

Miller Re-Elected by Gear Makers

E. W. Miller, of the Fellows Gear Shaper Co., was elected president of the American Gear Manufacturers Association at the seventeenth annual meeting held at Wilkinsburg, Pa., May 4-6. President Miller in his opening address congratulated the society on having secured the services of J. C. McQuiston as manager-secretary. Mr. McQuiston has just concluded one year in office.

Others re-elected to offices were first vice-president, John Christensen, Cincinnati Gear Co.; second vice-president, A. A. Ross, General Electric Co.; treasurer, J. H. Jackson, Pittsburgh Gear & Machine Co.; and the following members of the executive committee: A. A. Ross; F. W. England, Illinois Tool Works; A. C. Gleason, Gleason Works; W. G. Jones, W. A. Jones Foundry & Machine Co.

On the recommendation of L. R. Botsai, Nuttall Works, Westinghouse Electric & Mfg. Co., chairman of the membership committee, five new company members and eight academic members were elected to the association. Amendments to the constitution and by-laws adding more flexible membership provisions as proposed by E. S. Sawtelle, Tool Steel Gear & Pinion Co., were adopted.

B. F. Waterman, of Brown & Sharpe, chairman of the program committee, presented an unusually complete series of papers and events for the meeting. The technical discussion covered a wide range of topics and was exceptionally well rounded. Of the papers, that by E. F. Davis, metallurgist, Warner Gear Co., on "Heat Treatment of Gearing," is given at length in this number.

"Descaling Metals as Applied to the Cleaning of Heat-Treated Gears" was presented by Floyd T. Taylor, Bullard Co. Mr. Taylor explained the nature of oxides which form scale and their dangerous effects if not completely removed. He compared the several processes for their removal including the Bullard-Dunn process and reviewed the action of each.

Thomas Holloway, United Engineering and Foundry Co., in his address "Design and Manufacture of Large Gears for Industrial Service" gave the methods by which gears of large proportions are being made to a precision comparable to that of those much smaller. In particular he explained the application of large accurately cut gears to a strip mill and to a flying shear. The latter application together with the method of gear cutting were illustrated with moving pictures.

"Combination Motor and Reducer Units" was the subject of a paper by R. S. Marthens, Nuttall Works, Westinghouse Electric & Mfg. Co., Mr. Marthens traced the various designs of the type of drive since their introduction 1923. He pointed out the efficiency and compactness of gear motor drives and emphasized the need of greater standardization in this field.

Everett Chapman, of Lukenweld, Inc., gave a clear description of "Welded Steel Gears," including their construction and advantages. He illustrated early defects in welding practice and the means by which these had been overcome.

"Gear Lapping After Heat-Treatment" was the subject of an address by R. S. Drummond, president, National Broach & Machine Co. Mr. Drummond summarized lapping methods with emphasis on new developments and the proper selection of lapping compounds.

In a paper, "Tests on Worm Gear Speed Reducers," Chester B. Hamilton, Jr., president, The Hamilton Gear and Machine Co., presented the results of his work on worm gear capacities. The data cover 600 tests using gear sets with varying dimensions, pressure angles and lubrication.

In addition to the papers the members and guests were entertained by two short dramatic sketches. "A Sales Bout" showed the efforts of three salesmen, each attempting to secure an order from a chiseling purchasing agent. "Systematic Confusion in the Costly Department" compared the right and wrong means of cost control.

The association's annual dinner was well attended with George L. Markland, Jr., of the Philadelphia Gear Works, as toastmaster. Afterward the assembly was entertained with "An Hour of Science" by Dr. Philips Thomas, of the Westinghouse Electric & Mfg. Co.

Machine Tool Builders Vote to Postpone Exhibition

By an overwhelming vote members of the National Machine Tool Builders' Association decided not to hold the exhibition scheduled for Cleveland next September. The vote was announced at the 31st semi-annual meeting in Cleveland, April 24-25. E. A. Muller, president, King Machine Tool Co., who has been acting president since the resignation of H. S. Beal, was elected president. Richard A. Heald, treasurer and secretary, The Heald Machine Co., was elected first vice-president, and H. S. Robinson, secretary and sales manager, Cincinnati Shaper Co., was elected second vice-president. H. M. Lucas, president, Lucas Machine Tool Co., was elected to the board of directors to fill the vacant position resulting from Mr. Robinson's election.

The members of the association inspected the new underground exhibition

• INDUSTRIAL REVIEW •

For the first time in many months business in machinery and machine tools is looking up. Three factors are combining to bring this about: beer, expectation of general inflation, and the bad condition of the machinery in many plants which is forcing purchase of repair parts. Inquiries are much more numerous, and more businesslike. Scattered new orders are beginning to come in. Telegraphic orders for repair parts are being received.

Several real orders, although they were small ones, were placed in the New York and New England territories. Salesmen report an almost complete cessation of the gloom stories that have been current since the first of the year. Philadelphia has nothing of interest to report.

Pittsburgh machinery houses are feeling a reflection of the improvement in the steel business and are cheered by a few orders and a strong increase in inquiries—good ones. In Cleveland, beer, some of the food industries, and automobile parts plants are responsible for encouraging increases in employment. Night shifts are in order here and there. Repair and small tool orders are being telegraphed.

Supply business is growing in Detroit but the gratifying improvement in automobile shipments has not as yet led to any machine tool buying of consequence. In Cincinnati orders for materials are being placed and there is some interest in supplies and in used machine tools. Some new orders have been placed but not enough to have much effect.

St. Louis also reports improvement in supplies, but practically no machine tool demand. From Chicago, however, comes word of some new orders for machine tools, one or two from railroads, others from builders of brewers' equipment. Local printing press manufacturers are working to fill export orders. Material increases in employment are also noted. There has been little change in Milwaukee although a few shops have profited from beer business.

hall which will be finished in a few weeks and in which their exhibition will be held when business conditions are favorable, and ate luncheon there, thus being the first official guests at any function in the building.

Speakers at the dinner on Monday evening were President William E. Wickenden of Case School of Applied Science, and Willard M. Kiplinger of the Kiplinger Washington Service. Dean Dexter S. Kimball of Cornell spoke before the morning meeting.

Business Leaders Assist Drafting of Industry Control Bill

The successive waves of alarm that swept industry when details of the Black bill and Perkins amendment became known have subsided, and industrial leaders are now welcoming the prospect of greater control over business. Such was the spirit evident at the annual meeting of the U. S. Chamber of Commerce in Washington, May 2-5. This remarkable swing in sentiment is traceable to the realization that there is still time to aid in revised legislation looking toward inclusion of trade associations in the regulatory bodies. In his address before the chamber, Henry I. Harriman, president, emphasized that industry itself is the best agency by which its purposes can be achieved and offered the trade associations as the means to set up fair rules covering hours of labor, pay, prices and reserves for accident, sickness and old age. Working in this direction, a delegation from the Association of Trade Association Executives presented to President Roosevelt a resolution urging cooperation by industry in a plan to control the minority in many lines of business that do not adhere to trade practice agreements and that indulge in cut-throat competition. A broad bill has been drawn up providing for self-regulation of industry, suspension of the anti-trust laws where necessary, and setting up a government agency to pass finally on the cooperative agreements of trade associations.

Industry Plans to Employ 3,000,000

Twenty-five representatives of 56,000 manufacturers recently revealed a plan to employ 3,000,000 idle in private industry. This voluntary move is an attack on present economic conditions which would take its place alongside the government's public works program.

The plan has the approval of the National Association of Manufacturers and in addition is endorsed by a 9 to 1 vote of the Committee of the Nation, composed of more than 700 leaders in national life.

While not strictly a part of this move, a bill is being drafted which it is claimed would facilitate employment and will be presented to President Roosevelt this week. This bill will provide relaxation of the anti-trust laws to permit self-regulation of industry under government supervision. It will also provide for the granting of certain concessions to industry in return for the enlargement of working forces. The concessions are said to include help for trade associations in fighting demoralizing price-cutting, liberalization of credit to employers and a two-year Federal guarantee of bank deposits.

Trade Commission Rules Against Price Fixing

Stipulation agreements have been entered into between the Federal Trade Commission and four machinery companies by which the latter agree to discontinue resale price maintenance methods. The companies affected are: Sullivan Machinery Co.; Chicago Pneumatic Tool Co.; The Cleveland Rock Drill Co.; and Independent Pneumatic Tool Co.

These companies sold their products chiefly through dealer agents or dealer distributors, in restricted territories. Each company adopted a system whereby the trade cooperated in the enforcement of prices established by it and let it be known that it would require its customers to maintain these prices. Provisions insuring this were inserted in the companies' agency contracts.

Now these companies have agreed to cease and desist from the use of these methods and to discontinue the establishment or control of resale prices of their products, directly or indirectly.

R. R. Orders Still Lag

During the first quarter of 1933, Class 1 railroads of the United States placed in service 577 new freight cars, according to an announcement by the American Railway Association. This compares to 1,079 placed in service during the corresponding period of last year. On April 1, the railroads had 1,873 new freight cars on order compared with 2,974 on the same day last year.

One locomotive was placed in service in the first quarter, compared with three in 1932. New locomotives on order April 1 totaled three compared to 36 last year.

Metal Trades Association To Hold 35th Convention

Evidences of a strong program are apparent in the preliminary announcement of the 35th annual convention of the National Metal Trades Association, to be held at the Congress Hotel, Chicago, June 8. Among subjects of importance to metal manufacturers are: "The Forces Behind Social Legislation"; "Unemployment Insurance"; "Old Age Pensions"; "Our Economic Outlook"; "Our Financial Structure," and "Progress and Prosperity." Nominations for officers are as follows: president—Jacob D. Cox, president of the Cleveland Twist Drill Co.; first vice-president—Alexander Sellers, of William Sellers & Co.; second vice-president—Charles Strawbridge of the Goodman Mfg. Co., and treasurer—John W. O'Leary of Arthur J. O'Leary & Co. Nominations for the administrative council for a term of two years are: H. S. Chafee of the Builders Iron Foundry; Roe S. Clark of the Package Machinery Co.; Henry W. Johnson of the DeLaval Steam Turbine Co.; K. T. Keller of the Chrysler Corp.; J. R. Kinney of the Kinney Mfg. Co., and A. H. Tuechter of the Cincinnati Bickford Tool Co.

Management Conference in New York

Five papers will be presented before the single-day, annual general management conference of the American Management Association on May 18, Hotel Pennsylvania, New York. W. J. Donald, of James O. McKinsey & Co., will preside. At 10 a.m., Erwin H. Schell, department of business and engineering administration, Massachusetts Institute of Technology, will present "Centralization vs. Decentralization in Management for Present Conditions." This paper will be followed by: "Recent Developments in Budgeting," by Arthur Lazarus, of Arthur Lazarus & Co., and formerly consultant, Policyholders Service Bureau, Metropolitan Life Insurance Co.; "Industrial Pensions Systems," by Margaret L. Stecker, Industrial Relations Counselors, Inc.; "Pricing Policies," by Leverett S. Lyon, executive vice-president, The Brookings Institution, and "Management Implications of Recent Social Changes," by A. H. Williams, professor of industry, Wharton School of Finance.

March shipments of electric industrial trucks and tractors, as reported to the Bureau of the Census by ten leading manufacturers, consisted of 38 trucks and tractors as compared with 27 in February, and 20 in March, 1932.

Piez Retires From Link-Belt

Because of ill-health Charles Piez, chairman of the board, Link-Belt Co., has retired from active participation in the affairs of the company. George Paull Torrence, elected president in March 1932, becomes the company's chief executive.

Mr. Piez, born in Germany in 1866, received his technical education at the School of Mines, Columbia University. After his graduation in 1889, he entered the employ of the Link-Belt Co. as engineering draftsman. Seventeen years later, after he had attained the position of chief engineer and general manager of the company's Philadelphia Works, he was elected president of a consolidation of the three related companies: the Link-Belt Machinery Co., the Ewart Mfg. Co., and the Link-Belt Engineering Co.

Because of his fame as an organizer, Mr. Piez was in 1917 selected to be vice-president and general manager of the U. S. Shipping Board Emergency Fleet Corporation and later succeeded Charles M. Schwab as director general of this mammoth enterprise. In May, 1919, Mr. Piez returned to private business and continued as president of Link-Belt until 1924 when he became chairman of the board. He is a member of many clubs and technical societies and is a past president of the A.S.M.E., the Commercial Club of Chicago, and the Illinois Manufacturers' Association. He has been a director of the Drexel State Bank of Chicago and a member of the executive committee of the Museum of Science and Industry.

While retiring from active business, Mr. Piez continues as chairman of the board of the Link-Belt Co. He will make his home in Washington, D. C.

CHARLES PIEZ

Simpson Takes Charge of National Acme Manufacture

On April 21, C. W. Simpson, formerly works manager of the Windsor plant, was made vice-president and works manager of the National Acme Co. in charge of all manufacturing operations. A. E. Drissner, for some years chief engineer, was made vice-president in charge of engineering.

Mr. Simpson became connected with the Windsor Machine Co. in 1909 as head of the automatic department. In 1911, he was selected to go to Europe as that company's special representative. When National Acme purchased the Windsor Machine Co. in 1916, Mr. Simpson was retained as European representative until 1927, when he was recalled to manage the Windsor plant.

In 1906, Mr. Drissner was appointed direct representative for a combination of machine manufacturers comprising the Windsor Machine Co., Jones & Lamson Co., Fellows Gear Shaper Co., and the LoSwing Co. In 1910, National Acme requested his services as European agent. Until 1914, he made his headquarters in France, when he was recalled to take over the direction of the engineering department. When the Windsor Machine Co. was purchased, Mr. Drissner was appointed chief engineer dividing his time between the two factories.

C. W. SIMPSON

A. E. DRISSNER

Machinery Institute Elects Prout

At the annual meeting of the American Machinery and Tools Institute, held in Chicago on April 26, E. R. Prout of the Teletype Corporation was elected president. Other officers for the coming year are:

Vice-President—Frank Quick, Management Service Co.

Treasurer—Craig B. Hazlewood, First National Bank, Chicago.

Secretary—George R. Tuthill.

Directors—W. R. Mau, Vanadium Alloys Steel Co.; J. S. Kozacka, Lewis Institute; F. B. Coyle, International Nickel Co.; S. B. McHenry, W. D. Gibson Co.; A. C. Wais, Niles Tool Works Co.

Machinery Club Reaches 25 Year Mark

To celebrate its 25th anniversary, the Machinery Club of New York held a dinner on May 4, presided over by Edwin A. Stillman, thirteenth president, and the son of the founder, Francis H. Stillman. In 1907, the elder Mr. Stillman, then president of the Watson-Stillman Company, conceived the idea that the machinery men of the Metropolitan area should have a club like those enjoyed by trade groups. Two charter members are still interested, Henry Prentiss, of Henry Prentiss & Company, and Alonzo B. See, president of the A. B. See Elevator Company.

Correction

By error, an obituary notice (*AM*—Vol. 77, page 276f) stated that an Edward E. Ziegler was president of the Earle Gear & Machine Co., Philadelphia, whereas he was not associated with that concern. EDGAR P. EARLE, president, has held this position since organization of the company in 1903.

• PERSONALS •

W. C. WHITE, advertising manager of the Aluminum Co. of America, has been elected president and a director of the Aluminum Cooking Utensil Co. He will continue as advertising manager of the parent company.

DONALD B. PATTERSON, vice-president of the Harnischfeger Corp., Milwaukee, was recently elected chairman of the Electric Hoist Manufacturers' Association. FRANK F. SEAMAN, general manager of the hoist and crane division, Robbins & Myers Sales, Inc., was elected vice-chairman.

WILLIAM L. MCGRATH has been elected president of the Eclipse Machine Co., Elmira, N. Y. Mr. McGrath succeeds JOHN C. FERGUSON, who resigned April 30. MALCOLM P. FERGUSON has been made vice-president and a director.

•BUSINESS ITEMS•

The Davis & Thompson Co., Milwaukee, has acquired the Planigressive Reducer Co., and is transferring the equipment to its main plant. The line of speed reducers will be continued.

The R-S Products Corp., Germantown Ave. at Wayne Junction, Philadelphia, Pa., has executed an agreement with Ryan, Scully & Co., manufacturers of burners, furnaces and controls, whereby the former company will manufacture, sell and install all products. The R-S Products Corp. has also taken over the leasehold of the property previously controlled by Ryan, Scully & Co. F. J. RYAN is president and G. F. BEACH is chief engineer of R-S Products.

General and executive offices of the Worthington Pump & Machinery Corp. are now situated in the new office building adjacent to the plant at Harrison, N. J., in order to provide better coordination of manufacturing and sales operations. The local sales office will be continued at 2 Park Ave., New York, N. Y.

The Monarch Machine Tool Co., Sidney, Ohio, lathe manufacturer, has removed the Chicago office from 547 to 622 West Washington Blvd., where greater facilities will be used for exhibition and demonstration purposes. The New York office has been moved from Room 857 to Room 413 of the Graybar Bldg.

The Earle Gear & Machine Co., Philadelphia, Pa., has moved its sales offices in New York City from 95 Liberty St. to the Singer Building, 149 Broadway.

The Clark Tructractor Co., Battle Creek, Mich., has appointed HAROLD B. MADISON as branch manager with offices at 467 Canal St., New York. Mr. Madison has been with the company for 12 years as field engineer installing material handling equipment.

Goddard & Goddard, Co., Inc., Detroit, manufacturers of milling cutters, has appointed representatives as follows: H. F. MILLER, 394 Riverway Drive, Boston, Mass., for New England, and G. T. OSBORNE for the state of Indiana south of South Bend, with headquarters at 806 North Oakland Ave., Indianapolis.

The International Engineering Service, Detroit, Mich., has sent G. BEELER, consultant, to Europe for the purpose of placing American products on the European market. He will visit especially Belgium, France, Germany, Austria, Switzerland and Czecho-Slovakia.

American Manganese Steel Co., Chicago Heights, Ill., has announced that its nickel-chromium-alloys shall hereafter be known by the trade name "Amsco Alloys." A contract between the company and F. A. FAHRENWALD was terminated by mutual agreement, and the company retains the right to use certain patents issued and pending, while Mr. Fahrenwald has the exclusive use of the trade name "Fahralloy."

• OBITUARIES •

FRANCIS H. RICHARDS, 83, in recent years consulting engineer and designer for the Pratt & Whitney Co., Hartford, Conn., died April 29. Mr. Richards was one of the founders of the American Society of Mechanical Engineers. He took out numerous patents on machine shop tools and appliances, automatic weighing machines and other equipment. Firms for which Mr. Richards had acted in a consultative capacity were: Stanley Rule & Level Co. and the Cleveland Twist Drill Co.

CARLETON O. BELDEN, 50, vice-president and superintendent of the Ricker Mfg. Co., Rochester, N. Y., manufacturer of cranes, hoists, and winches, died recently.

A. R. CLIZBE, president of Clizbe Bros. Mfg. Co., Plymouth, Ind., manufacturer of grinding machinery, died recently at the age of 77. Mr. Clizbe organized the company in 1899.

WILLIAM P. HEBEL, 60, general superintendent of the Lattimer Foundry & Machine Co., Hazleton, Pa., died recently.

MATTHEW J. KONOLD, 57, a founder of the Warren Tool & Forge Co., Warren, O., died recently in Detroit.

FLOYD R. TODD, former president of the Deere Plow Co., Moline, Ill., died recently at the age of 58.

• MEETINGS •

AMERICAN FOUNDRYMEN'S ASSOCIATION. Annual convention and foundry and industrial exposition. June 20-23. Stevens Hotel, Chicago. C. E. HOYT, executive secretary, 222 West Adams St., Chicago, Ill.

AMERICAN IRON AND STEEL INSTITUTE. Forty-second general meeting. May 25. Hotel Commodore, New York. GEORGE H. CHARLS, secretary, 350 Fifth Ave., New York, N. Y.

AMERICAN MANAGEMENT ASSOCIATION. Annual general management conference. May 18. Hotel Pennsylvania, New York. K. B. ANDERSEN, secretary, 20 Vesey St., New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Second national lubrication engineering meeting. May 25-26. Pennsylvania State College. PROF. F. G. HECHLER, chairman, Pennsylvania State College, State College, Pa.

CASE SCHOOL OF APPLIED SCIENCE AND THE CLEVELAND ENGINEERING SOCIETY. Joint conference on "Re-Engineering for Economical Manufacture." May 10-12. Case School of Applied Science, Cleveland, Ohio. PROF. E. S. AULT, chairman.

NATIONAL METAL TRADES ASSOCIATION. Thirty-fifth annual convention, June 8. Annual meeting of administrative council, June 7. Congress Hotel, Chicago. J. E. HYNAN, national secretary, Peoples Gas Bldg., Chicago.

Meetings During Engineering Week Chicago World's Fair

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Semi-annual meeting. June 25-30. Stevens Hotel, Chicago. CALVIN W. RICE, secretary, 29 West 39th St., New York, N. Y.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting. June 26-30. Stevens Hotel, Chicago. C. L. WARWICK, secretary, 1315 Spruce St., Philadelphia, Pa.

MIDWEST ENGINEERING & POWER EXPOSITION. June 25-30. Coliseum, Chicago. Headquarters, 308 West Washington St., Chicago, Ill.

SOCIETY OF INDUSTRIAL ENGINEERS. Annual meeting. June 27-30. Stevens Hotel, Chicago. GEORGE C. DENT, secretary, 205 West Wacker Drive, Chicago.

THE ROUND TABLE

Is Talk Cheap?

"Say, Ed," said Al to his friend as they met at lunch, "I wonder if you know how lucky you are to be just a foreman, I was going to say, but that would be wrong. What I mean is that you are lucky to be a foreman instead of a manager."

"Thanks, Al, thanks. Why all the flowery language? Some guy said that 'uneasy lies the head that's crowned' or something like that. Nobody's been crowning you, have they?"

"No, not yet. If they did I could fight, but you can't fight against soft words without being a roughneck, and I don't want to be considered one. I thought, when I went in business for myself, that I could do as I liked. If I didn't like a man, I could fire him; if I didn't want to interview a salesman, there was no power on earth that could make me. I was wrong. A manager is a slave to politics and policy. For the first time, I've found out the meaning of 'noblesse oblige'. It means the obligations of authority. As a foreman I was shielded from unpleasant things; now I am one of the shock troops."

"What's you particular grievance? Being a manager has certainly not improved your disposition."

"My particular grievance just now is that I've been nailed to my desk all the morning listening to things I'm not interested in. It not only happened this morning, but there is hardly a day that two or three, or even more salesmen do not call. The trade papers are just announcing our moving and incorporation, and every manufacturer and jobber is trying to sell us something or get our good will. And all of them are two or three months late."

"Why not simply say you don't want anything and show them out?"

"You can't. The book of ethics for managing a business says it is not good form or good policy. It says, 'give every man a fair hearing.' I am naturally inclined to do it anyway, but it's getting to be too much for me."

"All you have to do is to sit and listen and say you do not want to buy anything. That's easy."

"So I thought, but it isn't. In the first place, the salesman has the toughest job there is at present. The next hardest job to his is having no job at all. Just about the time I perfect a technique for shortening the visit of a salesman, along comes a variety that isn't selling anything, and you have no chance of saying no."

"What kind of a salesman isn't selling anything?"

"A kind invented to counteract the annoyance business men are commencing to show at the persistent efforts of regular salesmen to make forced sales. The new man is called a 'missionary salesman'; his slogan is, 'I have nothing for sale.' This, of course, disarms the one interviewed, but he usually finds that the missionary will accept an order if pressed, or that he receives a visit later from a regular salesman on the strength of the good impression the missionary has made."

"I see. In other words they are hunting in packs now."

"They're doing everything except taking it away from you with a gun. I have always held that every salesman was entitled to consideration, but I didn't figure on depressions."

"The trouble with you, Al, is that you can't be the hail fellow well met. When a salesman comes in, and you don't want to buy anything just say so, and then tell him that you'll be glad to gab with him. If he's as hard after orders as you seem to think he is, he won't waste much time in a gab fest."

What is a fair policy for interviewing salesmen? Is Al justified in spending so much of his time in this way?

Discussion

Production Control

Contrary to what Ed believes, production control is as important for the small factory as for the large plant. In the small unit, the actual savings brought about by systematized production may not be as great as corresponding simplifications in a larger plant, but the savings represent a bigger part of the expense.

What kind of care can be exercised by men who, after all is said and done, are human? Can men, who have had trouble getting to work on time, or others who had an argument with their wives before they left, do the same quality of work, day after day? Business men have found to their sorrow, that they cannot depend on such things.

Production control was the answer which manufacturers had to work out. Controlled production is to date the best known method for minimizing discrepancies and inaccuracies caused by inherent human frailties which of necessity show up.

According to Al's statement, the compressor is good. Granted; then the best way to insure making another compressor which will be identically as good is to make it in the exact same manner. Al will need a system to get the best results and to insure that a few years

hence, when he must have controlled production, he will not have to change his methods to something entirely new.

—Fred Bennett,
Standard Products Company.

The only way a business of any size, large or small, can be run successfully is by a well planned system whereby every operation is fitted into sequence with the next. One or one hundred men can waste more time by hit-and-miss methods than is required to do many operations.

To build ten parts of one kind and five of another means that you have five complete parts at the end of that period, and so far as the flow of production is concerned, the time spent on the other five parts is out of step.

Good production flow is to have raw materials coming in at the rate of guaranteed need, and finished machines produced to meet guaranteed sales.

This gives a basis from which to work out cost-reducing plans. There may be some men in the world who can keep in their minds every detail that is necessary to carry through a program of work. However, I have never met such a person; the ones who claim to be able to do this, are the most costly to an organization, if for no other reason than they have their minds so cluttered up with the unnecessary detail that they do not have room for new ideas.

—H. M. Crooks.

The question is not so much whether Al should wait before installing a production control system, but how long he should wait. How will he know when to install the system? Probably, if he waits, it will be until he is in real trouble before he realizes the system is needed. Remember the story of the unlocked stable and stolen horse?

Furthermore, control systems cannot spring up like "Topsy". They must grow and develop with the organization to be really adequate.

If properly operated, a production control system is more than a means of following up orders. It is a labor saving device. By analyzing operations, similar ones can be run without extensive set-ups. Some standard parts can be run in larger lots rather than as needed. Short operations can be run with longer ones so that operators can handle several machines at the same time, as planers and lathes, milling machines and drill presses. It will be less likely that certain machines will be idle part time and overloaded at others. Operators, knowing they have jobs already scheduled for them, will be less inclined to take their time. Practically complete jobs will not be held up for lack of small items not finished in correct order. Spare parts for sudden, rush replacements will not be "out of stock" when most needed.

Al, start your system now, even if it is extremely simple. Extend and modify it as the need arises.

—Bernard Shereff,
Engineer, Standards Department,
American Hard Rubber Company.

Larger Quarters

Expansion on too large a scale has been one of the major factors in undermining many otherwise promising enterprises. A relatively small proportion of those who have found themselves in this difficulty have realized in time that every capital expenditure in the line of buildings and machinery is a fixed charge which must be applied as a direct cost of manufacture. In these days of low production, this situation has forcibly brought to light the folly of over-expansion beyond natural growth, using an index the normal demand for the product over an extended period. It is, therefore, imperative that the small operator as well as the large make a careful analysis of the output of his plant before any plan of expansion is entertained.

Personally, I believe that a plant should be worked to capacity both night and day so as to utilize to the maximum possible available buildings and equipment. One might point out that under this plan the machine life is materially reduced. This situation can be immediately taken care of by increasing the rate of depreciation. After all, which of the two burdens is the more easily handled, obsolescence or depreciation? I

would say depreciation. When equipment is being used to the limit both are taken care of readily, but during those times of restricted activity, we must admit that obsolescence seems to have a will of its own that is exceedingly uncontrollable. This condition is probably caused by the tremendous amount of development that is always accomplished during trade inactivity.

—Harold L. Wynn, *Executive Engineer,*
Pacific Electric
Manufacturing Corporation.

High Finance

Taking it for granted that the Al and Mason compressor is an A-1 product and that Ed is satisfied in that direction, I would consider the proposition from the following angles:

If Al and Mason have sold compressors during the present period and without agents, the chances are all in their favor with improvement in business and with agents looking for territories. Furthermore they apparently have a definite immediate field, the breweries.

As far as buying the stock back is concerned I would discount that offer to some extent. No doubt Al and Mason would and could buy it back in case of cold feet on Ed's part, but in case of real trouble, I would not rely on it.

Summing it all up I would offer to buy the stock at perhaps ten to twenty dollars per week; that would take from one to two years to pay for it in full. If they weather that period, they will be all set, and if they fail in the meantime only a certain percentage of the $1000 would be lost.

If they do not fail and Ed should need his money he can probably get it back from Al and Mason as promised; or Williams, who tried to get fifty shares and can get only twenty, may be glad to buy out Ed. — J. C. P. Bode.

Renovizing

Al's natural aim will be the production of compressors at lowest possible unit cost after all expenditures have been figured. If he remembers that each investment must show logic against this background, he will not go far wrong. He will find that a portion of what he has to spend on improvement will go toward the most-needed items of equipment, while another part will fall to the improvements he has in mind.

Any man's judgment is likely to be warped just a little by pet notions and theories unless he watches himself closely. The ability to perceive and differentiate between actual needs and wants is a habit, as much as it is anything else, and as such it may and should be cultivated. Both Ed and Al have truth in their arguments; the path of excessive and expensive cheapness, leads into oblivion.

Ed, of course, is particularly correct with regard to changes in conditions. "Conditions change constantly—one must change with them." This would be an excellent motto for Al to hang on the wall of his new plant. Since changes are constantly taking place, it follows that the more flaxible one can make his layout, equipment and organization, the better off he will be.

—John E. Hyler.

American Machinist
REFERENCE BOOK SHEET

Characteristics of Monel Metal—III

TABLE I—Mechanical Property Ranges of Standard Products

	Tensile Strength lbs. per sq. in.	Yield Point lbs. per sq. in.	Proportional Elastic Limit lbs. per sq. in.	Elongation in 2 inches per cent	Reduction in Area per cent
Rod and bar					
Cold drawn					
Annealed	70,000- 85,000	25,000-35,000	20,000-30,000	35 - 50	65 - 75
As drawn	85,000-125,000	60,000-95,000		15 - 35	50 - 65
Hot rolled	80,000- 95,000	40,000-65,000	25,000-40,000	30 - 45	50 - 65
Forged	80,000-105,000	60,000-85,000	45,000-65,000	20 - 40	
Wire, cold drawn					
Annealed	70,000- 85,000				
No. 1 temper	95,000-110,000				
Regular	110,000-140,000				
Spring	140,000-175,000				
Plate, hot rolled	80,000- 95,000	25,000- 35,000		25 - 35	
Sheet and strip					
Full-finished sheet	65,000- 80,000	25,000- 35,000	20,000-30,000		
Cold rolled					
Annealed	65,000- 80,000	25,000- 35,000	20,000-30,000		
Full-hard sheet	100,000-120,000	90,000-110,000			
Full-hard strip	100,000-125,000	90,000-115,000			
Tubing, cold drawn					
Annealed	65,000- 80,000	25,000- 35,000	20,000-30,000		
As drawn	90,000-105,000	60,000- 75,000		15 - 25	
Casting	65,000-100,000	30,000- 60,000		5 - 35	5 - 35

TABLE II—Minimum Mechanical Properties of Standard Products

A. Cold-Drawn Rod and Bar

Range of diameter or thickness inches	Tensile Strength lbs. per sq. in. minimum	Yield Point lbs. per sq. in. minimum	Elongation in 2 inches per cent minimum
Annealed			
Rounds, squares, flats, hexagons	70,000	25,000	35
As Drawn			
Rounds			
1/8 to 1/2	110,000	80,000	15
Over 1/2 to 1 1/4	100,000	75,000	20
Over 1 1/4 to 2	95,000	70,000	20
Over 2 to 3	85,000	60,000	25
Squares, hexagons, flats			
Up to 1/4	90,000	75,000	20
3/8 to 1/2	85,000	65,000	25
Over 1/2	85,000	60,000	25

B. Hot-Rolled Rod and Bar

Range of diameter or thickness inches	Tensile Strength lbs. per sq. in. minimum	Yield Point lbs. per sq. in. minimum	Elongation in 2 inches per cent minimum
Rounds			
Up to 1/2	85,000	45,000	30
Over 1/2 to 1	80,000	40,000	30
Over 1 to 2	90,000	50,000	30
Over 2 to 3	85,000	45,000	30
Over 3	80,000	40,000	30
Squares, hexagons, flats. All sizes	80,000	40,000	35

C. Forged Rod and Bar

Range of sizes inches	Tensile Strength minimum	Yield Point minimum	Elongation minimum
Rounds, rough-turned and specially straightened			
Over 3 to 6	90,000	70,000	25
Over 6 to 9	85,000	65,000	25
Over 9 to 12	80,000	60,000	30
Squares, hexagons, flats			
Up to 2	95,000	75,000	20
Over 2 to 3	90,000	65,000	25
Over 3 to 6	90,000	60,000	25

D. Cold-Drawn Wire

Temper	B. & S. Gauge	Tensile Strength lbs. per sq. in.
Annealed	All	85,000 maximum
No 1 temper	All	95,000 minimum
Regular	All	110,000 minimum
Spring temper	0 - 2	140,000 minimum
Spring temper	3 - 8	145,000 minimum
Spring temper	9 - 14	150,000 minimum
Spring temper	15 - 19	160,000 minimum

E. Plate: Sheet: Strip

Product	Tensile Strength minimum	Yield Point minimum	*Elongation minimum
Hot rolled plate	80,000	25,000	25
Full finished sheet	65,000	25,000	35
Cold rolled sheet and strip			
Annealed	65,000	25,000	35
Full hard	100,000	90,000	

*Values vary with thickness.

F. Cold-Drawn Tubing

	Tensile Strength minimum	Yield Point minimum	Elongation minimum
Annealed	65,000	25,000	35
As drawn	90,000	60,000	15

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Characteristics of Monel Metal—III

Table III
Erichsen Ductility Test on Sheet

Thickness, Inch	Condition	Depth to Fracture Inch	Load, Lbs.
.062	annealed	.560	8,000
	hard	.315	6,000
.031	annealed	.500	3,500
	hard	.225	2,000

Table IV
Torsional Strength

	Hot Rolled Lb. per sq. in.	Cold Drawn 1 in. diameter lb. per sq. in.
Breaking strength	61,000-63,000	90,000-95,000
Yield point	26,000-35,000	75,000-80,000
Proportional limit	20,000-29,000	45,000-50,000

Table V
Hardness Ranges

Form and Condition	Brinell Number (500 kg.)	Brinell Number (3000 kg.)	Shore	Rockwell B, 1/16" Ball, 100 kg.
Annealed; Hot rolled, forged	80-105	118-135	18 and under	68 and under
	125-150	150-175	19-23	70- 80
Hard sheet, strip	.....	.....	40-45	95-100
Rod, normalized	190-220	220-250	35-45	90-100
Cast	90-110	105-115	14-16	50- 60
Cast (hard)	.....	up to 340	..	to 35*

*Rockwell C.

Table VI
Strength of Hot Rolled Rod at Elevated Temperatures

Temperature Degrees Fahr.	Ultimate Tensile Strength lbs. per sq. in.	Limiting Creep Stress lbs. per sq. in.	Proportional Limit lbs. per sq. in.
Room	82,000		34,000
212	78,000		32,000
392	73,000		29,000
572	76,000		28,000
752	72,000	50,000	23,000
932	62,000	22,000	14,000
1112	45,000	5,000	
1292	31,000	2,000	

Table VII
Tempers Available in Cold Rolled Sheet and Strip

	Sheet		Strip	
	Shore	Rockwell B	Shore	Rockwell B
Dead soft	16 and under	60 and under	16 and under	60 and under
Soft			17-18	61-68
Soft-skin hard	17-20	61-73		
Skin hard			19-20	69-73
Quarter hard	21-24	74-82	21-24	74-82
Half hard	25-30	83-89	25-30	83-89
Three quarter h'd	31-35	90-93	31-35	90-93
Hard	36-40	94-97	36-40	94-97
Full hard	over 40	98 and over	over 40	98 and over

Physical Constants

Density	8.80
Weight, Pounds per Cubic Inch	0.318
Melting Point	2370-2460° F. 1300-1350° C.
Specific Heat (20-400 degrees Cent.)	0.127
Heat Expansion—	
(25-100 degrees Cent.)	.000014
(25-300 degrees Cent.)	.000015
Heat Conductivity (0-100 degrees Cent.), c.g.s.	.06
Electrical Resistivity (at 0 degrees Cent.) microhm per cubic centimeter	42.5
ohm per mil-foot	256
Coefficient of Electrical Resistivity, per ° C.	.0019
per ° F.	.0011
Magnetic Transformation	95 ° C. 203 ° F.

MACHINING — Cold drawn metal machines more readily than hot rolled or annealed. Any good cutting oil is satisfactory. Angles for a lathe tool are: back rake, 8 deg.; side rake, 14 deg.; front clearance, 6 to 8 deg., and side clearance, 6 deg. For turning castings with a 1/8-in. cut and 1/32-in. feed, the average speed is 60 ft. per min.; for rolled metal, 70 ft. per min. Drilling is done at a cutting speed of 30 to 50 ft. per min. and a feed of 0.005 in. per revolution. Standard twist drills are used. For reaming, use the spiral-flute type and a slow speed of 10 to 15 ft. per min. Tapping difficulties are encountered from the tendency of the tough chip to stick in the flutes. Tapping speeds are from 15 to 20 ft. per min. It is advisable to use taps with two or three lands and shallow flutes. A lip should be ground back of the cutting edge so that the chip will curl better through the flutes and clear itself. When tapping completely through the metal, it is good practice to grind the cutting edge to an angle of 10 to 15 deg. to the axis of the tap with a chamfer for four to five threads. Milling cuts range from 70 to 80 ft. per min. with a 1/8-in. cut and a feed of 0.005 to 0.010 in. per revolution. Teeth of plain milling cutters should be ground at a slight taper, widest at the cutting edge in order to prevent binding and tearing of the metal. Grinding is done much as with steel. An under-cut or rake on the teeth of milling cutters is of benefit.

DRAWING AND PUNCHING—Rules governing the reduction of diameter and depth of draw from the blank are the same as those commonly used for steel. Diameter of the first cup is usually two-thirds the diameter of the blank. With slight diameter reduction, as high as 30 per cent reduction in wall thickness may be obtained in one draw. A clearance of 0.004 in. is satisfactory for drawing the lighter gages of metal. Tendency to wrinkle is less with monel metal than with steel, but the former requires more power. Punches for monel metal should be about 75 per cent stronger than for steel and can be made of tool steel.

(See Reference Book Sheets on the same subject (AM-Vol. 63, page 403 and page 445).

Courtesy of The International Nickel Company, Inc.

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Sharp Corner Grinding—*Discussion*

HAROLD CLAY

In grinding a sharp corner, the sequence of operations described by Walter Wells (*AM*—Vol. 77, page 86) is the best that can be employed, but from experience, I have found that by setting the wheel-head to an angle of 30 deg. and dressing the wheel as shown in Fig. 1, it is possible to eliminate entirely the chances of any wheel drag as would be the case in using a wheel set at 90 deg. with the work axis. This procedure will also give a much better finish to the side of the tool, because the two surfaces of the wheel that come into contact with the work are curved surfaces.

If the corner to be ground should be at the bottom of a narrow channel,

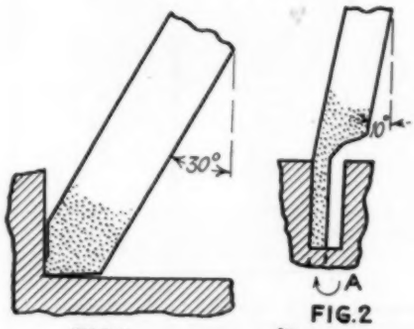


FIG.1

FIG.2

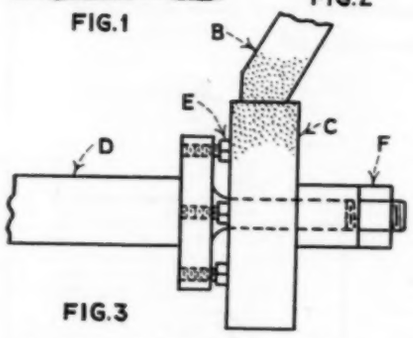


FIG.3

Angular wheel settings eliminate drag. Fig. 3 shows a set-up for obtaining a 0.001 radius on a hard wheel

we can still use the same method with a little different dressing of the wheel. Referring to Fig. 2, it will be seen that the same method is employed, but the wheel-head should be set at an angle less than 30 deg. We will take the angle of 10 deg. for the setting in this instance, although this can be varied according to the width of channel.

After dressing the side of the wheel and the periphery, the back of the wheel is cut away, using an old broken carborundum wheel in order to preserve the diamond, and then finishing with the diamond until width *A* (Fig. 2) is about 0.010 in. less than the channel. The operation of grinding is then the same as would be with wheel in Fig. 1. This method can be employed in channels as small as 0.20 in. wide, which will take care of the majority of work any toolmaker would be called upon to handle.

It is unnecessary to go so fine as the grades of wheel used by Mr. Wells, (P grade, 60 grain, Norton scale) because it is quite possible and practical to use an L grade, 150 grain wheel (Norton scale) and dress with a needle point diamond for the final dressing, which will give a corner with only a 0.003 in. radius. However, it is many times necessary to have a corner with a radius not greater than 0.001 in. in which case a wheel of harder grade would have to be used. It is easy to do this by using a Norton M grade, 100 grain wheel. The only difficulty experienced when a diamond is used for dressing this wheel is that, because of its hard, fine structure, a certain amount of vibration is caused by the diamond coming into contact with the hard surface that tends to break down the corner of the wheel. By employing the following method, this vibration is entirely eliminated, and the important part of the tool preserved.

Fig. 3 indicates the method that has proved to be the best for this operation. *B* is the wheel to be dressed, *C* is a soft open structure wheel, preferably a discarded carborundum wheel about 4 in. in diameter and abour ¾ in. in thickness. This is mounted on a floating arbor similar to the one illustrated at *D*, which is used for mounting circular forming tools, the small screws *E*, are for the purpose of truing the mounted wheel so that it will run approximately true with the axis of the arbor. The truing of the periphery is accomplished by light tapping with a soft metal hammer or other soft material.

When this is accomplished to within 0.001 in. on the periphery the mounted wheel is placed within the work centers, and the nut *F* tightened just enough to hold the wheel securely in place. After this the wheel-head is advanced to the work and the operation of grinding performed the same as if we were doing an ordinary cylindrical grinding job, taking care that the point we wish to preserve does not pass beyond the edge of the dressing wheel.

This is continued until sufficient has been removed from the wheel we are dressing, to give the fine point we need which can be checked by cutting into a piece of stiff card and checking with a small square or any other method which the operator may find convenient. It is easy to do this and does not take any more time than to dress the wheel with a diamond, provided the soft wheel is left mounted on the arbor for future use. If the grinding operation is carried out slowly it will be found that there will not be any larger than a 0.001 in. radius in the corner when checked in an optical measuring machine, which is about as small as we could wish for in a ground tool.

Chromium Plating Cast Iron —*Discussion*

R. E. CLEVELAND

Plant Manager, Chromium Corporation of America

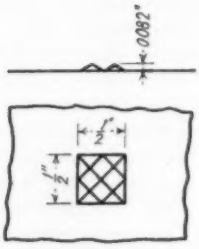
The article by W. E. Splain (*AM*—Vol. 76, page 1226) would lead to the supposition that chromium plating, when applied directly to cast iron, would leave acids that deteriorate the iron and would also give an unserviceable coating that would not withstand wear. These impressions are entirely erroneous and probably caused by the quality of the plating job.

For heavy industrial uses, it is seldom wise practice to employ an undercoating of soft metal. In most instances there is considerable pressure and heavy wear that can cause the soft undercoating metal to break down. The strength of adherence to such metal is no greater than the inherent strength of the soft metal itself. We are able to obtain an adherence bond between our chromium and the underlying cast iron so strong that any fracture of the plate from the underlying metal will occur in the iron.

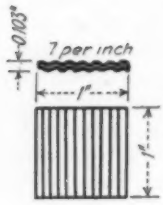
Undercoatings are employed in the great bulk of chromium plating work which is in the decorative field. This is done for economic advantage, because the softer metals may be buffed and polished much more cheaply than the steel and chromium, if chromium alone were applied. Also, the amount of chromium required for rust-proofing is so great that the cost would be prohibitive. Therefore, the common practice of using undercoatings for decorative work is correct and economical. In industrial uses where heavy coatings of chromium are necessary to meet hard service, it is seldom advisable to use undercoatings, unless the problem is purely corrosion.

Press Work Pressures

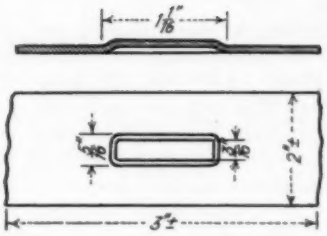
Series V—*Embossing*



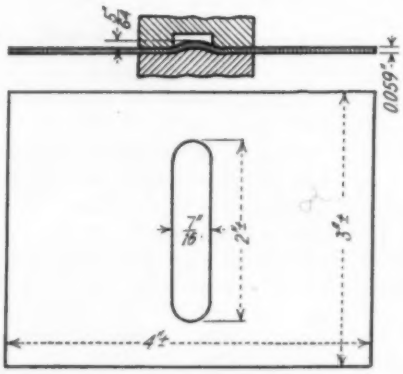
Material--Soft steel, 0.018 in. thick
Operation--To emboss four raised spots
Pressure--1,600 lb.



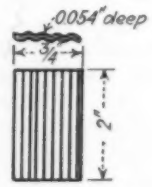
Material--Soft steel, 0.062 in. thick
Operation--Corrugations 0.039 in. deep
Pressure--44,000 lb.



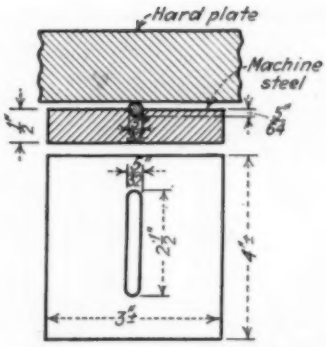
Material--Sheet machine steel, 1/16 in. thick
Operation--To emboss a panel
Pressure--5,000 lb.



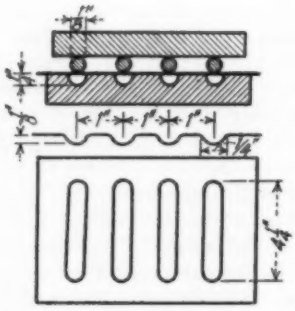
Material--Sheet steel, 0.059 in. thick
Operation--To emboss a panel
Pressure--7,000 lb. for embossed portion, or 3,500 lb. per in.



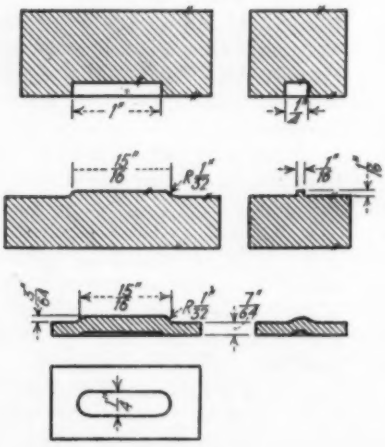
Material--Soft steel, 0.050 in. thick
Operation--Corrugations 0.054 in. deep
Pressure--36,000 lb.



Material--Drill rod, 5/32 in. in diameter
Operation--To embed pieces of drill rod in a plate of machine steel
Pressure--68,000 lb.

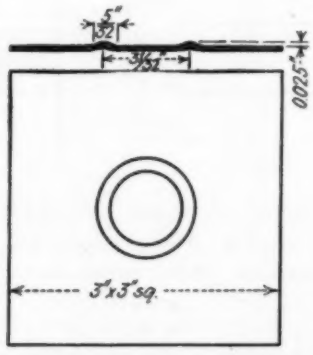


Material--Steel, 0.022 in. thick
Operation--To emboss four ribs 1/8 in. high
Pressure--20,000 lb.



Material--Ordinary sheet steel, 7/64 in. thick
Operation--To emboss a panel
Pressure--14,000 lb.

Material--Soft brass, 0.010 in. thick
Operation--To emboss letters 1/32 in. high using type metal die
Pressure--6,000 lb.



Material--Soft sheet steel, 0.034 in. thick
Operation--To emboss a ring 31/32 in. in diameter
Pressure--10,000 lb. or 3,333 lb. per in. of contour

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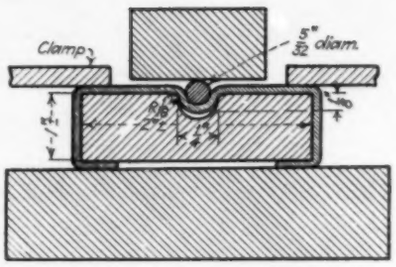
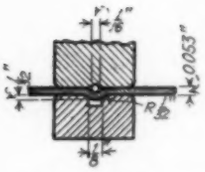
Press Work Pressures

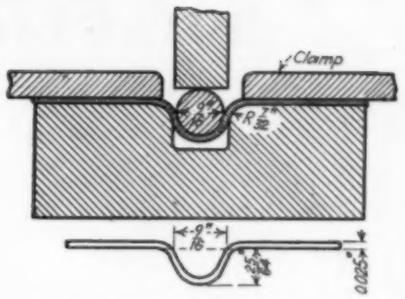
Series V—*Embossing*



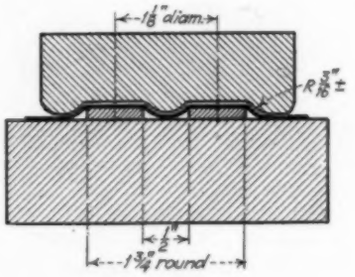
Material--Steel, 0.050 in. thick
Operation--To emboss a groove by stretching the metal
Pressure--32,000 lb.



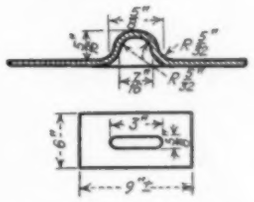
Material--Soft steel, 0.053 in. thick
Operation--Emboss bead 3-1/2 in. long
Pressure--14,000 lb., or 4,000 lb. per in.
Test made in testing machine



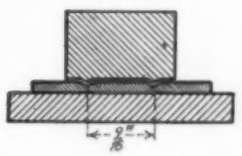
Material--Soft copper, 0.025 in. thick
Operation--To emboss a groove 4-1/2 in. long
Pressure--5,500 lb.



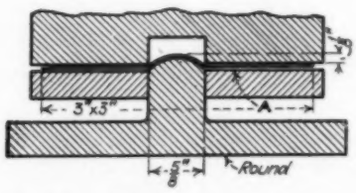
Material--Soft steel, 0.018 in. thick
Operation--To emboss a ring 7/64 in. high
Pressure--3,000 lb.



Material--Soft sheet steel -
A. 1/16 in. thick
B. 5/64 in. thick
Operation--Form depression shown
Pressure--A. 17,000 lb.
B. 20,000 lb.
Test made in testing machine



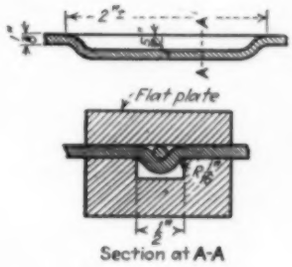
Material--Medium hard copper
Operation--Emboss a round groove 9/16 in. in diameter by 0.040 in. deep
Pressure--16,000 lb.
Test made in testing machine



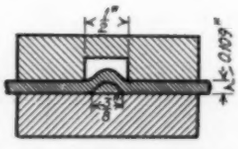
Material--Sheet tin, 0.013 in. thick
Operation--Produce a smooth flange at A
Pressure--500 lb.
Test made in testing machine

Raised lettering

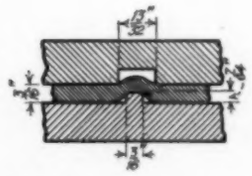
Material--A. Soft aluminum, 0.012 in. thick
B. Tin, 0.009 in. thick
Operation--Emboss to a depth of 0.021 in.
Pressure--A. 8,000 lb.
B. 20,000 lb.
Tests made in testing machine



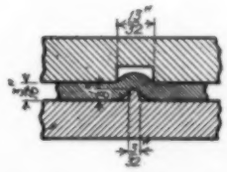
Material--Sheet steel, 1/8 in. thick, 8x8 in. square
Operation--Emboss groove in center of sheet
Pressure--18,000 lb.
Test made in testing machine



Material--Soft steel, 0.109 in. thick
Operation--Emboss bead 2 in. long by 1/8 in. high
Pressure--16,000 lb.
Test made to determine pressure required for stamping letters in barrel heads



Material--Machine steel, 3/16 in. thick by 1 in. wide
Operation--Emboss a lateral groove
Pressure--21,500 lb.
Test made in testing machine



Material--Machine steel, 3/16 in. thick by 1 in. wide
Operation--Emboss a groove
Pressure--26,500 lb.
Test made in testing machine

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• IDEAS FROM PRACTICAL MEN

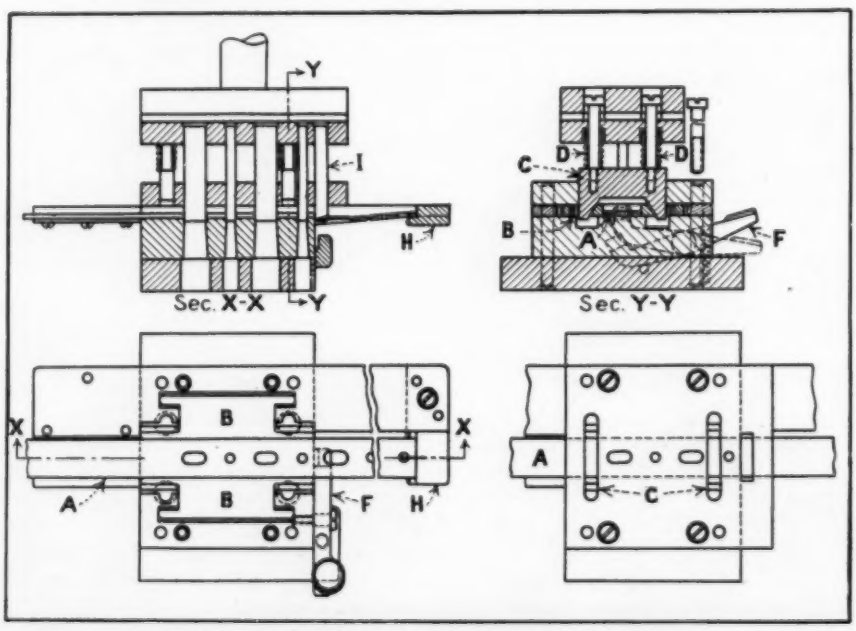
Device for Centering Bars in Press Tools

W. AALREP
Engineer, Dusseldorf, Germany

In punching flat bars for structural work, variation in the width of the bars will cause the punched holes to be out of center. To obviate this difficulty, the press tools illustrated were designed.

Referring to the illustration, the bar to be punched is shown at *A*. Instead of a single, stationary guide for the bars, two sliding guides *B* are provided and are controlled by the two cams *C*. As the ram descends, and before the punches contact with the bar, the angular projections on the cams engage holes in the guides, drawing them toward the center and centering the bar. Continued downward movement of the ram compresses the springs *D*, keeping continuous pressure of the cams on the guides and the guides on the bar while the punches do their work.

The bar is fed from left to right, and for the first punching its end is brought against the jump finger-stop *F*. For each punching thereafter, the end of the bar is brought against the stationary stop *H*. At each punching after the first, the punch *I* cuts off pieces of the correct length.



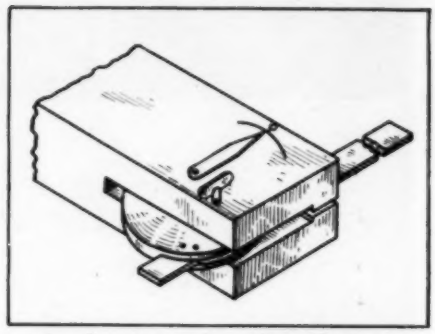
A method of centering bars in a punch press to insure holes being located in the center

Graduated Diemaker's Square
Discussion

JOHN E. HYLER

Referring to the article by Charles Weslow under the title given above (*AM*—Vol. 77, page 153), I was much interested in the application of a cam to a diemaker's square. The idea of graduating such squares is, of course, not new, as squares graduated directly on the stocks can be had in the open market.

Where it is desirable to make a diemaker's square in the shop in which it is to be used, the one illustrated is, I think, much better than either of the ones described by Mr. Weslow. In fact, I feel that in certain cases, the square illustrated herewith is superior to squares obtainable in the market. Not for diemakers alone, but the angle scope of the square is so wide that it is very useful to the patternmaker for obtaining the correct draft on his patterns and for laying off angles.



Another type of graduated square for diemakers and for tool work of various kinds

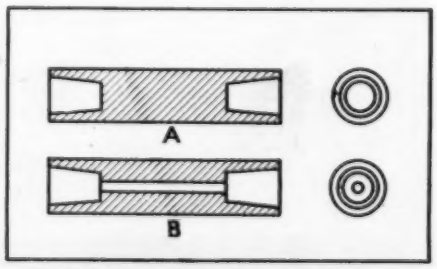
Both the design and construction of the square are so plain as to need very little explanation. The blade is secured in the slotted disk by two small screws, the heads of which are indicated by black dots. The construction makes it easy to attach blades of various shapes and widths. The center pin is tight in the disk and rotates with it. A hole is drilled and tapped in the stock for a thumbscrew to bind the disk, and consequently the blade at any determined angle. A pointer is attached to the center pin, and an arc is scribed on the stock as a guide for the graduations. All graduations have been omitted from the sketch, zero or 90 deg. only being shown.

Vent Hole Assists in Hardening

EMIL WITTMANN

In hardening some parts, such as the one shown at *A* in the illustration, they had to be plunged in the quenching bath in the direction of their axes to prevent warping. The air trapped in the blind holes prevented the quenching bath from reaching the interior surfaces and left that part softer than the others.

To obviate the trouble, vent holes



Drilling a vent hole prevents trapping air in blind holes in hardening

were drilled through the axial centers of the pieces, as at *B*, preventing the air from being trapped and permitting the quenching bath to come into contact with the interior surfaces. The result was uniform hardness throughout.

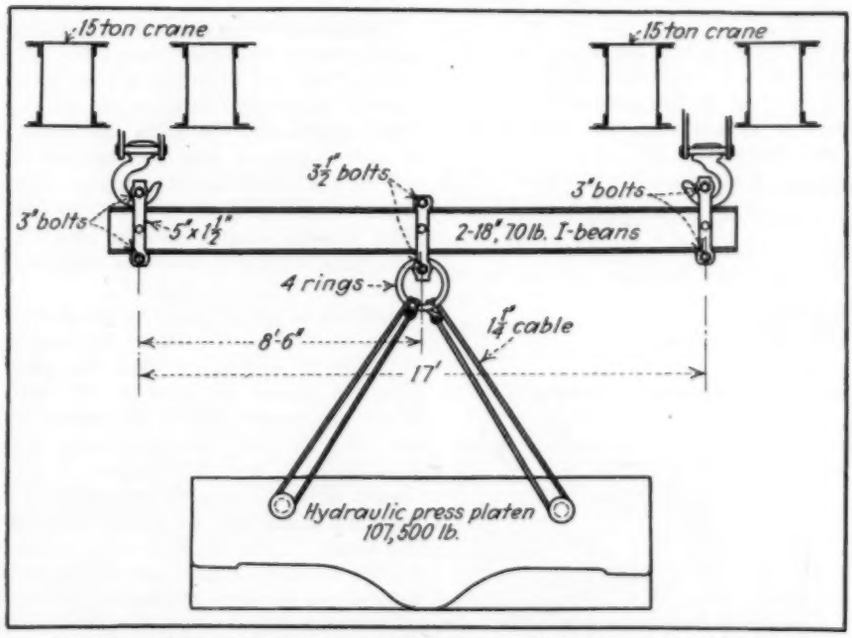
An Unusual Equalizer for Cranes

W. J. TANGERMAN
Shop Supt., Union Metal Products Co.

Sometime ago, we faced the task of unloading several heavy (50-ton) hydraulic press platens from well cars, without equipment sufficiently heavy to do the job. The only lifting equipment available was a pair of 15-ton cranes, and since they were of different manufacture and had been purchased at different times, the rate of hoisting of one was about twice that of the other. In the emergency, we devised and built a load equalizer of the type illustrated. Two 18-in. by 70-lb. I-beams were cut to 19-ft. lengths, then assembled with 5x1½-in. sections of arch bar as shown. The arch bar was drilled with 1⅛-in. holes where each 3 or 3½-in. hole was to come, then expanded by driving taper pins through the holes. This gave a wider section near the holes and retained the sectional strength of the bars at these points. The I-beams were pulled together at each end and one section of arch bar put at either side, their top and bottom 3-in. bolts and a ¾-in. through bolt at the middle serving to position them. The center arch-bar sections had pins ½-in. larger, and three sections of bar were used there, one between the two sections of I-beam.

With this arrangement, each crane could be centered over one of the building columns, thus making fairly safe its lifting of a load slightly over its capacity. Further, the equalizer made certain that neither crane would take more than half the load (if the hoists were kept reasonably in line) and enabled the operators to maintain the proper respective hoist positions, in spite of the disparity in hoisting rates.

In use, the cables were hooked over rings as shown, or in some cases grommets were used, which could be put on or removed by removing the bottom pin. We experienced no difficulty with this arrangement, even though the load was so great that it was necessary to slack off the load in order to trolley over.



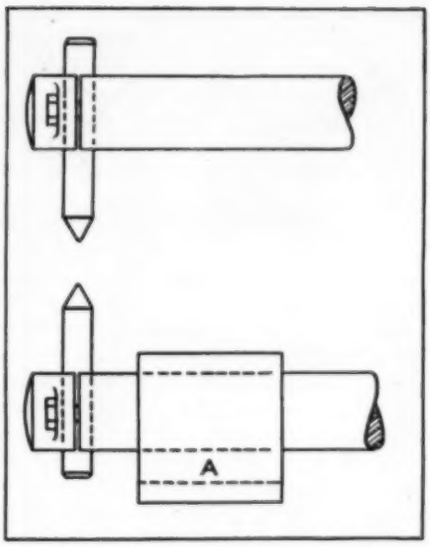
Handling 50-ton castings from freight cars to the shop with two 15-ton cranes. The special equalizer beam prevented either crane from taking more than half the load

Reducing the Heating Power of a Spot-Welder

L. KÀSPER

Electric spot-welders are built in a variety of sizes, the size depending upon the class of work to be done. Each machine is equipped with a rheostat for adjusting the current to the required strength. However, the range of adjustment is limited, so that the use of a large machine for light work may result in burned or defective welds.

A condition of this kind was recently overcome in the manner shown in the illustration. A cast-iron sleeve, or bushing, *A* was hung loosely over the lower horn of the machine, adding inductive reactance to the circuit, thus reducing the heating power to the required limit. The size of the sleeve was determined by experiment. This method is recommended as a matter of expediency, rather than for efficiency when viewed from the standpoint of power consumption.



Cutting down the heat in a spot welder by using a cast-iron ring on one horn reduces efficiency but prevents burning thin metal

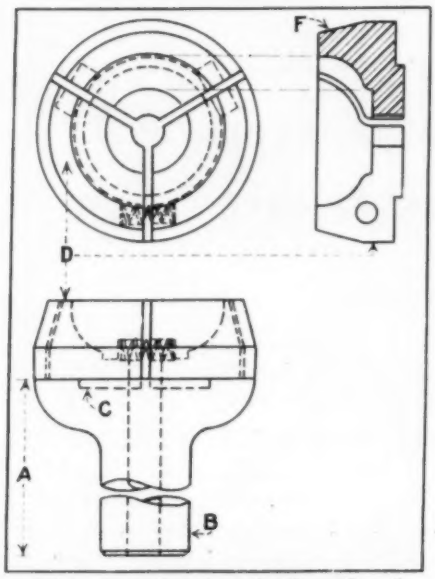
A Special Spring Chuck

CHARLES F. KRAUT

For many years we used spring collets of conventional design for holding door knobs while the shanks and part of the bodies were being machined in a turret lathe. In spite of the care and the materials used in making them, the collets would break after limited service. Since they could not be repaired, new ones had to be made, entailing considerable expense.

We experimented with collets having three, four, and six radial slots terminating in round holes and others in elongated holes running both parallel and at right angles to the slots. Steels of different brands were used and the thickness of the walls was varied, but the breakage continued.

Finally, we designed the spring chuck illustrated, and have had no further trouble from breakage. The overall length of the solid part of the chuck is indicated at *A*, the portion *B* being a sliding fit in the hole in the machine spindle. The front end is recessed at *C* for the reception of a short pilot on the split jaws *D*, which are normally held



This type of spring chuck replaced collets that broke too frequently

in the open position by helical springs. The front ends of the jaws are tapered to 17 deg., as at *F*, the taper corresponding to the taper in the conventional cap (not shown) screwed on the spindle nose of the machine.

In operation, the chuck is pushed forward by the usual collet-closing mechanism, closing the jaws on the work by forcing their tapered ends into the tapered hole in the nose cap of the machine.

Two Tricks in Punching

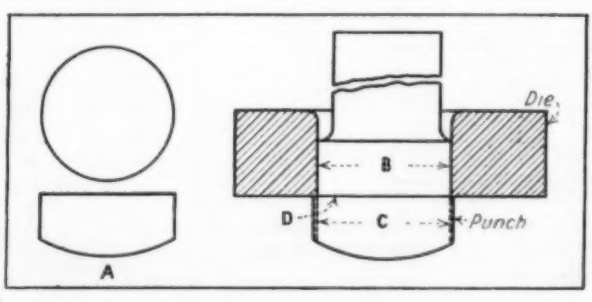
CHARLES KUGLER

Referring to the article by W. J. Tangerman, under the title given above (*AM*—Vol. 76, page 1234), I am reminded of a trick in the production of shallow cups, a sample of which is shown at *A*. The stock is ⅛-in. soft copper and the cups were made at one stroke of the press by the tools illustrated.

The diameter of the hole in the die is the same as that of the outside of the cups; also it is straight, smooth and highly polished and the upper edge is slightly rounded. The diameter *B* of the punch is a snug fit in the die. The part *C* is slightly tapered so that the cups can easily be stripped from it. The shoulder *D* must be square and sharp, because it is the part of the punch that "pinches" the cups from the strip.

After the cups have been formed, continued descent of the ram causes the punch to push them clear through the die. As the ram ascends, the tops of the cups having sprung open slightly, contact with the bottom of the die at the edge of the hole and are stripped from the punch.

If the punch is made in one piece, it is evident that the shoulder *D* can not be ground when it gets dull, therefore, the part *C* should be detachable.



Using a two-diameter punch to draw thin copper cups. The springiness of the cup edge stripped it on the up stroke

Formulas for Operators of of Jig Boring Machines
Discussion

C. M. CONRADSON

Referring to the article by William W. Johnson under the title given above (*AM*—Vol. 77, page 124), I wish to say that from a mathematical standpoint, no exception can be taken to the clear analysis presented by Mr. Johnson. It is, however, not necessary to use trigonometry in solving this problem. Geometry is ample, more direct, more simple and better adapted to the use of a very busy drafting room or toolroom.

The essential points of Mr. Johnson's diagram are reproduced here and, for the present purpose, definite values have been assigned to the given quantities as being more understandable by those readers really requiring mathematical instruction.

Referring to the diagram: Assume that $AB = 13.2$ in.; $AC = 17.5$ in.; and $BC = 17.5$ in. Required x and y. From A drop a line normal to BC. From B to the foot of the normal line is assumed as x, and from the foot of the normal line to C is $BC - x$.

Obviously:

$$y^2 = 13.2^2 - x^2. \quad \text{Or } y^2 = 17.5^2 - (17.5 - x)^2$$

Hence:

$$13.2^2 - x^2 = 17.5^2 - (17.5^2 - 35x + x^2)$$

Simplifying:

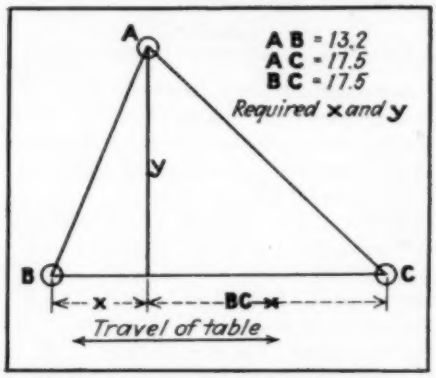
$$35x = 13.2^2 = 174.24$$

$$x = 4.978285$$

$$y = \sqrt{13.2^2 - 4.978285^2} = 12.2252$$

The time required to solve this problem was less than ten minutes. Where extreme accuracy is required, I prefer to solve a problem of this kind by ordinary mathematical methods. A seven-place table of logarithms will, however, in the hands of a skilled computer be more rapid and about as accurate.

No present effort will be made to solve this problem for the use of polar coordinates, as practically all jig boring machines are adapted for the use of rectilinear coordinates. By the use of theorum III, trigonometry, the trigonometrical solution is quite simple, since it involves finding two angles and the distance from one side to the center of the circumscribed circle.



Making it easy for jig-boring machine operators to locate holes

Chuck for Ring-Gear Blanks

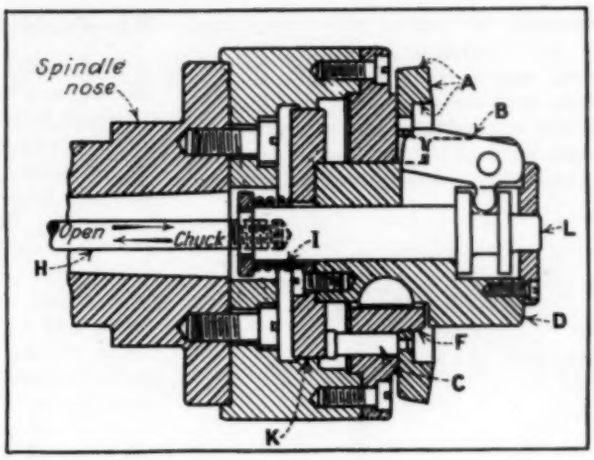
A. L. HARTLEY

R. K. LeBlond Machine Tool Company

The demand for a chuck for accurately holding bevel ring-gear blanks for machining on a high-production basis brought about the development of the chuck illustrated. It holds the blanks in such a manner that the surfaces *A* can be machined simultaneously. The three expanding jaws *B* are 120 deg. apart and are located 60 deg. from the pilot pins *C*, which are also 120 deg. apart.

A blank is placed over the retainer *D* and is entered on the seat of the locator *F*, where it is rotated until the pilot pins will engage in holes in the web. When the draw-in rod *H* is moved to the left, the coil spring *I* holds the guide plate *K* and the retainer *D* stationary until the jaws are expanded and force the blank against the shoulder of the locator. The blank is driven both by the friction of the back of its web against the shoulder of the locator and by the pilot pins.

When the draw-in rod is moved to the right, the clamp stud *L* is moved forward and contracts the jaws. At the



Special chuck to hold blanks for ring gears while turning the face and outside and while boring inside of tooth surface

same time, the guide plate and the retainer are moved forward under pressure of the spring until the guide plate contacts with the heads of the pilot pins. Continued movement in the same direction causes the pilot pins to force the blank from its seat on the locator, and it can then be readily removed.

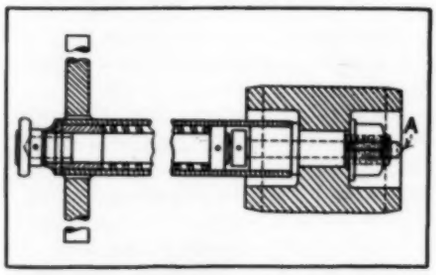
Tools for Gaging and Marking Cylinder Diameters

A. W. DILTS

Inspection Department, Studebaker Corporation

In finding the diameter of cylinder bores we use plug gages mounted on shanks having cross-handles for ease in handling. In order to save time and prevent mistakes in marking the sizes of the cylinder bores on top of the cylinder blocks, I designed a stamping device to be used with each gage, as shown in the illustration.

Flush with the bottom of the plug gage, at *A*, is the face of a steel stamp carrying the size of the gage. The



Spring-actuated stamp for marking size of bores on cylinder blocks. It follow the spring centerpunch in design

body of the stamp extends above the top of the gage and a collar pinned at the top prevents it from falling out. A hollow shank was provided, in which are a coil spring and a plunger, the plunger terminating in a knob above the cross-handle. On the top of the knob the size of the plug gage is stamped in large figures.

Upon finding a cylinder, the bore of which fits the plug gage in the workman's hand, he withdraws the gage from the bore and sets it on top of the cylinder block adjacent to the cylinder just gaged. He then grasps the knob at the top of the shank and lifts it up, raising the plunger and compressing the spring. Letting go of the knob, the spring forces the plunger down and it strikes the top of the stamp body, stamping the size of the bore on the cylinder block. Formerly, the workmen had to set down the gage, pick up a stamp and a hammer and stamp the size on the cylinder block, not only making lost motions, but being liable to pick up the wrong stamp.

It is, of course, understood that marking the bore sizes on the cylinder block is for convenience in selecting the piston for each bore, the piston being picked out by the size stamped upon it.

A V-Slide for Restricted Space

ERNEST C. ALLEN

In the sketch is shown a V-slide for use where the required travel is short and where the space is so restricted that there is no room for the conventional nut and thrust collars.

The slide and the guide are made and fitted in the usual way and a tap hole is drilled the entire length of the assembly. The hole is then tapped to the center from each end, a right-hand tap being used at one end and a left-hand tap at the other, making two right-hand and two left-hand half nuts, two being in the slide and two in the guide. The slide is then removed from the guide and is reassembled in reverse position and a body-size counterbore is used to bore out the threads at one end. Again removing the slide from the guide, it is reassembled in the first position. In this position there is a half nut of one hand at one end of the guide and a half nut of the other hand at the opposite end of the slide, one being above and the other below, as shown in the sectional view at the left.

All that is needed to complete the device is a screw having right- and left-hand threads at opposite ends. To conserve space the screw should have a hexagon hole at one end, the same as in safety setscrews, a wrench being used to adjust the slide.

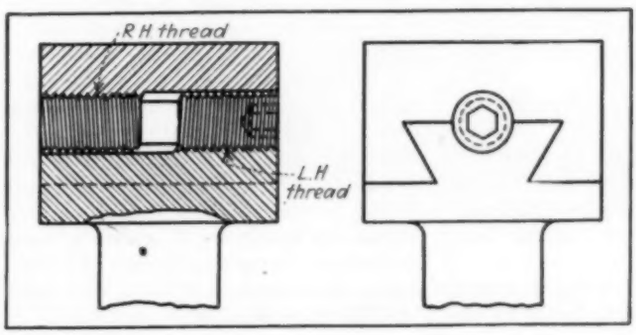
Equalizing Pressure of Vise Jaws—*Discussion*

E. F. TEIGH

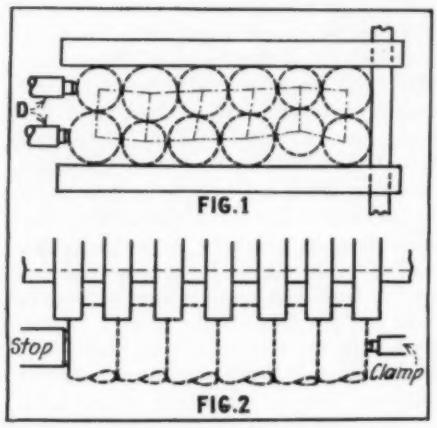
Ham, Richmond, Surrey, England

Where accurate work is required, the method advocated by Charles Kugler in an article under the title given above (*AM*—Vol. 76, page 1169) is a dangerous doctrine, in as much as there is no guaranty that the errors arising from the varying diameters of the components will not become cumulative. In all cases of clamping components one against the other, the possible cumulative error must be guarded against in designing the fixtures to be employed.

Mr. Kugler states that the setscrews *D* used for end clamping are for the purpose of accommodating varying diameters. While they will probably perform as he states, they will do it only at the expense of the relative positions of all the components. The clamping action under such conditions is obtained



Half threads, right and left hand, make compact construction possible in a dovetail cross-slide for use in a restricted space



Showing how cumulative errors may affect clamping pieces of unequal diameters in some devices previously illustrated

by the equalizing of the clamping directions obtained from the vise itself, and from the setscrews through the movement of each component. The condition ultimately obtained is shown in Fig. 1. The different position that each component might take is indicated by the dotted lines joining their respective centers.

The effect of such a construction upon the particular component is shown in Fig. 2, in which it will be seen that if ganged cutters are employed, the central positions of the tongues can be guaranteed. The only correct method by which the centrality of the tongues can be obtained is to locate each component with reference to its center, and this can be done only by providing individual locaters and clamps, such as are described by Francis Paquin and Frank W. Curtis (*AM*—Vol. 76, pages 948 and 1235, respectively).

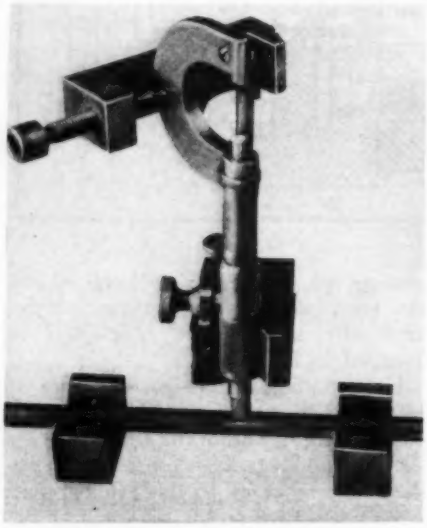
An Improvised Testing Set-Up

W. H. MOORE
Hamilton, Ontario, Canada

Part of the repair work on a nailing machine included the straightening of a number of short spindles, all of which were bent in the middle. Since the work had to be done on the job and there were no conveniences, I had to make shift with what tools were in my kit. The most important part of the work, testing the spindles for straightness, was done with the set-up illustrated.

A glance will show that the tools consisted of two small V-blocks, a surface gage, a clamp, and a 1-in. micrometer. The micrometer was clamped to the spindle of the surface gage in such position that the thimble was slightly ahead of the body.

After an attempt to straighten a spindle, it was placed in the V-blocks and revolved, the end of the ratchet knob of the micrometer touching the high spot, and a reading was taken. The thimble of the micrometer was then adjusted so that the end of the ratchet knob touched the low spot. A reading taken and compared with the former



A micrometer, a surface gage and V-blocks test the spring of a spindle

reading showed to a thousandth just how much the spindle lacked of being straight. Straightening and testing operations were continued until all the spindles showed straight by this test.

SEEN AND HEARD

JOHN R. GODFREY

Torch Hardening of Gear Teeth

It's a bit strange how methods and devices crop up in the old shop to meet a need of the moment and drop out of sight, only to be re-invented after a long period. Such an instance is the local hardening of gear teeth by the use of the oxyacetylene torch. One of its early incarnations was in the plant of the Pierce-Arrow Co. in Buffalo in 1920. The early use of the self-starter involved the cutting of gear teeth on the rim of the flywheel. Cast iron teeth broke out and required dentistry at frequent intervals. So Pierce-Arrow tried cast steel of high enough carbon to harden. The torch only heated the tooth locally and, when the temperature was high enough, the hot tooth was quenched by rolling into water. This method was illustrated in the *American Machinist* during the year mentioned.

The coming of the steel ring gear, shrunk on the flywheel, made the torch hardening unnecessary, and it disappeared, only to be revived when other conditions made it seem desirable.

Wheelhead Heat Expands Work

Close limits on machined parts are teaching us a lot about the effect of heat. A recent instance brings out the need for care very clearly. Complaints that an automatic machine was grinding the hole too large led to some careful investigation. Settings were all O.K. and the size should have been right, but it wasn't when measured at the machine. Observation showed that the operator would take a piece out of the chuck and lay it on the wheelhead while loading the next piece. After loading he would gage the piece just done, only to find that it was oversize. And all because the heat of the wheelhead expanded the hole in the short time the piece was in contact with it. It pays to watch temperatures very closely.

Smelting Iron with Pulverized Coal

Here is another case where invention was the grandmother of necessity. Powdered coal has been used as a fuel for at least 40 years, coming into its own very slowly in many cases. Steam plants were in operation with powdered coal in New York City in the early 90's and can hardly be called common practice even now. From Scotland, however, comes a new application in the shape of a rotary pulverized fuel furnace for smelting cast iron. The claim is made that "the use of pulverized coal with preheated air is an important step toward the smelter's ideal of a very hot flame, simple control of the furnace atmosphere to give the minimum oxidizing conditions, quick response to alterations in feed, and low fuel costs." Perhaps this may give coal a new lease of life in its battle with oil by opening another field of usefulness.

Refrigerator Mechanics

Whether or not "service industries" can absorb all who are replaced by machines in the production plants, is a much debated question. But there can be no doubt as to a crying need for reliable service on many kinds of mechanisms used by the general public. The household refrigerator is a shining example of this, according to those in close contact with this field. The large makers can and do maintain service shops. Many of the smaller makers do not — cannot. This seems to be an opportunity for a number of good mechanics to make a field for themselves, men who can analyze troubles and have skill enough to make satisfactory repairs, quickly. With millions of the household refrigerators in use there should be remunerative work for many.

SHOP EQUIPMENT NEWS

Hall Continuous Planetary Milling Machine

Operations classified under circular milling and thread milling can be done on standard parts at a high rate of production and to unusual guaranteed accuracy by a precision milling machine now offered by The Hall Planetary Co., Fox St. & Abbotsford Ave., Philadelphia, Pa. Production of this continuous planetary milling machine with six heads can be judged from the accompanying table. At 2 r.p.m. of the machine, 12 pieces of work are produced per minute. Accuracy of plus or minus 0.00025 in. are guaranteed at the production rates shown in the table.

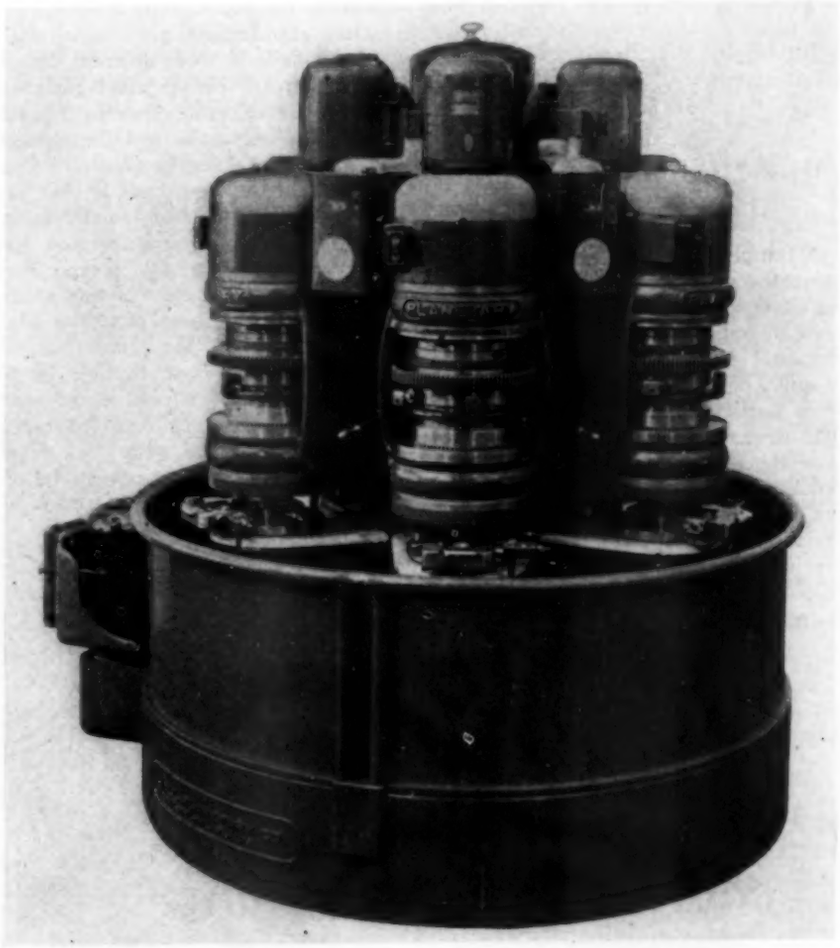
Some of the automotive parts that can be machined are: Differential carriers and housings, hubs, rear-axle housings, shock absorber housings, bearings, pinions and gears. Pipe fittings can be threaded by the "Planathreading" method. Besides these two fields, the machine will handle ordnance work, including shells of all sizes and their component parts.

The continuous planetary machine is an adaptation of the standard horizontal single and multiple-head planetary milling machines. Six machines have been built into one in order to reduce floor space and make it possible for one man to operate all six. Because of the planet-like orbit taken by the cutter while milling around the stationary work, the principle has been called "Planathreading" and "Planamilling." Features of this method of machining are: (1) Circular tangency of cutter and work, giving cutter teeth long sweep of metal with several teeth in the cut, stepping up production; (2) eccentrics allow vernier control of production accuracy with tolerances guaranteed to 0.00025 in.; and (3) concentricity and alignment of simultaneously milled threads and bores.

In no case is the machine stopped once it has been started. Cutters are replaced when dull by walking around the machine while it is kept running, the whole operation taking 20 seconds. It is possible to control the diameter milled in the work after cutters have been reground. This is done by using cutters in heads one to six consecutively, and regrinding in between to specified sizes for each numbered head. It is also unnecessary to stop the machine to locate the work with respect to the cutter. A wedge actuated by a large graduated dial allows adjustments to 0.00025 in. while running. To achieve these accuracies the machine is said to have been designed and built to closer limits than those demanded by the work.

The machine is designed for automatic loading from a conveyor passing the machine. Two or more different pieces of work can be loaded into alternate heads. As few as two heads can be bought with the machine and standard heads added later as production warrants. There is a possibility of taking both roughing and finishing cut without unchucking the work. This is done in two ways: (1) Mounting a roughing and finishing cutter on the same arbor and consecutively registering the work with each cutter; and (2) indexing the holding fixtures between roughing and finishing heads.

As shown, the machine consists of six standard planetary milling heads mounted vertically upon a central supporting casting. The entire machine and the six heads revolve continuously about a central column. Chucking fixtures directly beneath each planetary head automatically chuck and locate the work. Two cam rings bolted to the stationary central column are sufficient to control the milling feeds of the six planetary heads and likewise control the automatic operation of the six holding fixtures. A vertical motor drives the entire machine through a large spur ring



Circular milling and thread milling operations can be done to guaranteed accuracy of 0.00025 in. and on a high-production basis by the Hall Continuous Planetary Milling Machine

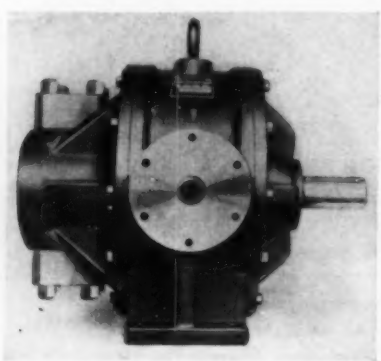
Production Chart for Continuous Planetary Milling Machine

Product	Operation	Material	Floor to floor per 60 sec.	Days run 9 hr. day
Ammunition.....	Thread milling nose of shell 1½ in. P.D.x¾ in. long thread.....	Cr. Ni. steel.....	12	6,480
Pipe coupling.....	Complete simultaneous thread milling of both ends, 8¼ in. P.D.x3½ in. long thread.....	High carbon steel...	2	1,080
Auto hubs.....	Form milling two complete bearing seats 5 in. I.D. and 2 in. I.D. bores and shoulders....	Steel forging.....	10	5,400
Bearing race.....	Form milling entire bore and ball grooves.....	Cr. Mo. steel.....	40	21,600
Differential carrier..	Simultaneous complete thread milling both ends.....	Mal. iron.....	8	4,320
Shock absorber.....	Simultaneous complete finish milling all of inside.....	Steel forging.....	10	5,400

gear beneath the chip apron. The six milling spindles are driven by individual vertically mounted motors through silent chain drive. Feed gearboxes run directly off a large diameter spur gear bolted to the stationary column. Since spindle drive to each head, milling feed control, and fixture throw outs are individually controlled, the operator is enabled to throw the six units in and out of production as circumstances warrant. The operator unloads the automatically opened fixtures and reloads them with a fresh piece of work as each one passes him. Floor space is 8 ft. by 8 ft.; height, 8 ft.; weight, 30,000 lb.; main drive motor, 7 hp.

"H-P-M" Radial Hydraulic Pumps

A complete series of radial pumps for generating pressure employed in operating hydraulic powered machinery has been placed on the market by the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio. The pump is offered particularly for heavy production machines requiring high pressures. It is of the positive displacement, multiple radial plunger, oil pressure type. Output is both variable in volume and reversible in direction of flow. Six sizes are built, ranging from 1 to 100 g.p.m., with pressure capacities up to 3,000 lb. per sq.in.



Lord Plate-Form Vibration-Absorption Machine Mountings

The Lord Manufacturing Co., Erie, Pa., has standardized a line of plate-form mountings to protect instruments and machinery from shock and vibration. Besides the protection to the machinery itself, it is often necessary to isolate the equipment so that disturbing vibrations and noises are not transmitted to the surrounding area.

These standardized plate-form mountings are made in three different designs; that is, square plate, round plate and stamped holder, as illustrated. The rubber is bonded to the metallic elements and takes the stress in shear. A characteristic of the mountings is that they are many times as stiff radially as axially. This permits a suspension comparatively stable in any desired direction and very soft, with a low natural frequency in the direction of the vibratory thrusts. At the same time, the hysteresis or internal friction of the rubber reduces the amplitude at resonance and damps out repeated oscillations.

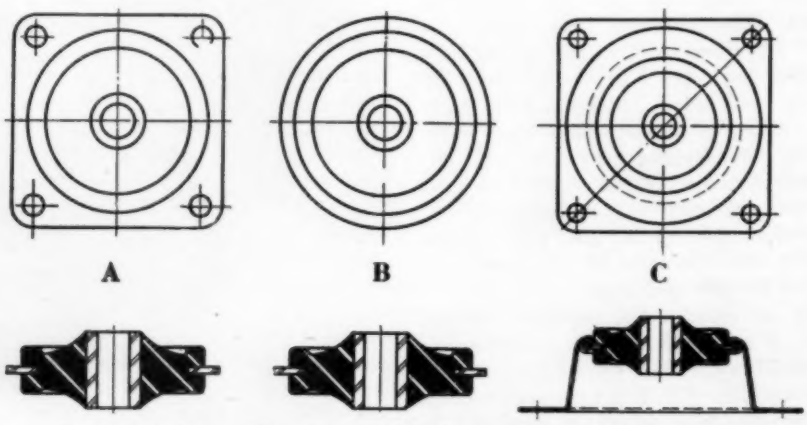
The plate-form mountings consist of a washer-like metal plate and a central metal tube connected by rubber bonded to the tube and plate. A load rating based on a $\frac{1}{16}$ in. deflection under load has been adopted. The square plate form has four corner holes for fastening purposes. The round plate form is applicable for special holders while the stamped holder raises the mounting proper for clearance above the supporting surface. A double mounting, formed by connecting the central sleeves of two single units, doubles the axial softness over the rating of the individual units. The double mounting also has more free movement transversely as well as axially and is of value for those conditions in which there is a disturbing vibratory movement in more than one direction.

All three types of plate form mountings are made in load ratings from 1 to 90 lb. each to give a deflection of $\frac{1}{16}$ in. Nineteen sizes cover this range.

"Murex" Straight Gap Welding Process

Welding without veeing or grooving of plate edges can be undertaken by the straight gap welding method developed by the Metal & Thermit Corp., 120 Broadway, New York, N. Y. This "Murex" straight gap method saves time since plates can be used as they come from the mill, or flame-cut plates may be welded without removing the smooth surface oxide from the edges. It is also said that less weld metal is required. Tests showed that the welds bent flat without rupture and also showed elongation of from 50 to 60 per cent.

As shown by the illustration, plates are lined up with the welding edges parallel, and a steel backing strip, $\frac{1}{8}$ in. thick or heavier is used to close the bottom of the gap. The space between



Lord Plate-Form Mountings—(*A*) Square-type with four screw holes; (*B*) Round-type for mounting in special holders; (*C*) Stamped-type for raising the mounting above the support

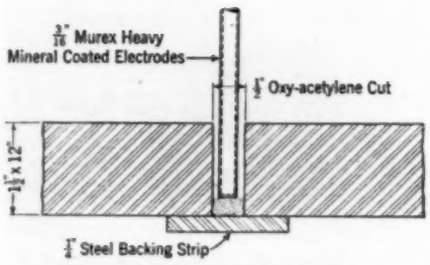
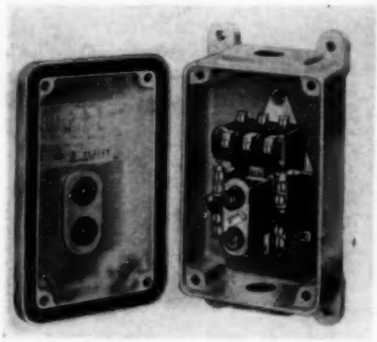


Diagram showing method of arranging plates and backing strip for "Murex" straight gap welding of a 12-in. seam in 1½-in. plate

the plates varies according to the size of the electrodes being used. For example, where 5/32 in. electrodes are employed, the gap is ½ in. An initial layer of weld metal, which seals the lower edges of the gap is first laid down, using normal amperage. Then, with the current raised slightly, the weld is built up layer upon layer. The electrode is moved from side to side in the gap while welding and is tilted to wash away some of the plate edge. The slag is removed from each layer, leaving a smooth deposit which fillets up on the edges. When the building up is completed, an annealing layer is placed over the top. The backing strip is then removed, the first layer of weld gouged out, and the weld is finished by running one or more layers and an annealing layer on the under side.

Allen-Bradley Splash-Proof Starter

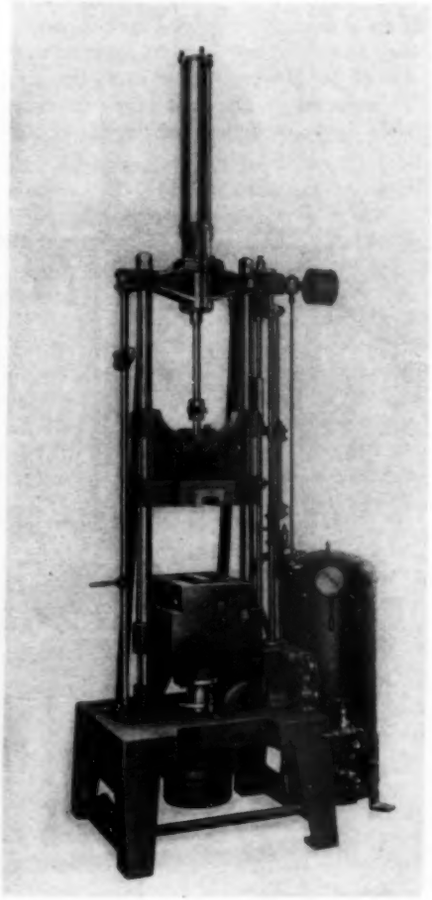
An addition to the standard line of starters has been made by the Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis., in the form of a splash-proof, hand-operated starter for motors up to 3 hp., 110 volts, 5 hp., 220 volts, and 7½ hp., 440-550 volts. Operating mechanism is identical to that of the standard Bulletin 609 hand-operated starter. The cadmium-plated cabinets are provided with rubber cover gaskets. Splash-proof pushbuttons in the cabinet cover actuate the switch and exclude moisture from the switch mechanism.



"Pneumatic" Double-Action Drop Hammer

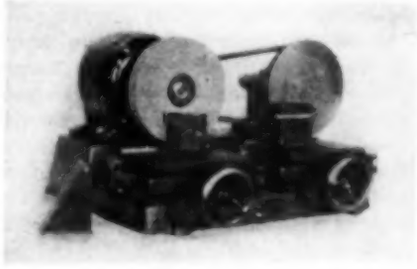
A shockless, vibrationless, double-action drop hammer that is said to require no foundation, springboards or other shock absorbing devices, and that may be installed on any floor of a building, has been placed on the market by the Pneumatic Drop Hammer Co., 123 Heath St., (Roxbury District), Boston, Mass. A mobile head mounted in the supporting frame of the machine replaces the anvil common to an ordinary drop hammer. This mobile head is impelled upward and is so designed that its weight and rate of motion are such as to develop through a short distance of travel an amount of energy equal to that developed by the dropping head at the moment of impact. Thus, the two forces applied in opposite directions are spent in the work. The machine is pneumatically operated and is designed to use air at 80 lb. pressure. A feature is the means provided for arresting the lifting momentum of the drop head, which is brought to a non-oscillating stop at the end of the stroke without shock.

Double-action hammers are readily fitted with anvil extensions consisting of plain box-type die-holders with renewable hardened and ground steel inserts for either round or rectangular dies. The drop head is fitted with a special steel shoe for holding dies, and with an opening machined to suit requirements. Machines can also be fitted with tilting base box-type die-holder or with a poppet-type anvil extension arranged for either four or six poppets.



Wells No. 150 Grinder for Lathe and Planer Tools

Grinding and lapping of tool bits, either of high-speed steel or tungsten carbide, can be undertaken with a No. 150 grinder announced by the Wells Mfg. Co., P. O. Box 613, Greenfield, Mass. The machine consists of two units, one for grinding and the other



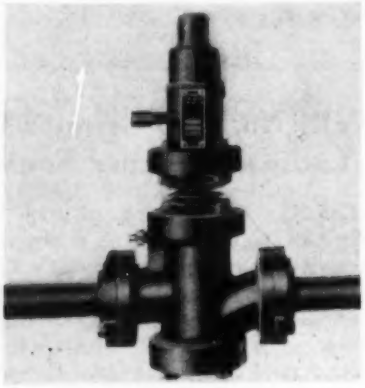
for lapping. For roughing out the tool, a special face-grinding wheel is mounted on the motor shaft. This wheel is in two parts, the outer ring being a coarse abrasive for the rough grinding, and the central section of finer grain for finish grinding. On the right-hand side of the machine is a two-part lap of similar construction. The shape of the tool is controlled by the form of a master block. Blocks are furnished in different shapes for grinding the various shapes of tools with the correct rake and relief.

Willson Transparent Cup Goggle

The "blinder" feeling is eliminated by the transparent cup goggle developed by Willson Products, Inc., Reading, Pa., for protection of workmen. Light passes through the walls of the cup undimmed and permits normal eye condition. The goggle has more room than ordinarily and is well ventilated. It can be used with or without spectacles, and is light in weight.

Brown Area-Type Flow Meter

For measuring the flow of heavy oils, the Brown Instrument Co., Philadelphia, Pa., has developed an area-type flow meter which does away with the necessity for a complex arrangement of piping and seals required between the meter body and pressure taps when using standard differential and orifice-



type flow meters. Heavy oils must be heated in order to flow freely. The cost of the steam and the long period of waiting required when the meters (differential and orifice types) are started from cold are objectionable. If the oil will flow through the pipe it will flow through the body of the area-type meter and it is measured directly. The flowing fluid enters the meter body at the entrance and passes under the piston, through the orifice, and is then discharged. Since the piston is free to slide vertically, it will be lifted, exposing a section of the rectangular orifice in the sleeve. The piston comes to rest when the pressure drop through the meter is equal to the weight of the plunger divided by the area of the piston. The position of the piston is measured by the inductance bridge system. The meter is accurate at low flows as well as at large flows. One use for the meter is to maintain accurately a fixed rate of firing of oil-fired furnaces.

Wells No. 130 Grinder for Routing Cutters and Engraving Tools

The Wells Mfg. Co., P. O. Box 613, Greenfield, Mass., has developed a No. 130 grinder for the purpose of sharpening routing cutters and engraving tools. When grinding a routing cutter on the angle, the cutter is inserted in the quill. The quill is then set in the locator or gage block, aligning the quill by a pin entering a slot in the head of the quill. The end of the cutter locates against the hardened gaging surface and the flat of the cutter will locate on the locator blade. This insures the cutter's location with the flat side in correct position and the point projecting the right distance. The quill is then removed from the locator and placed in the workhead, to be set to a dial. The quill is held down in the workhead by the left thumb and revolved with the right hand, passing the cutter over the face of the emery wheel. A thumb screw on the front of the machine is used to feed the workhead. The flat face or flat end of the cutter is ground by holding it against

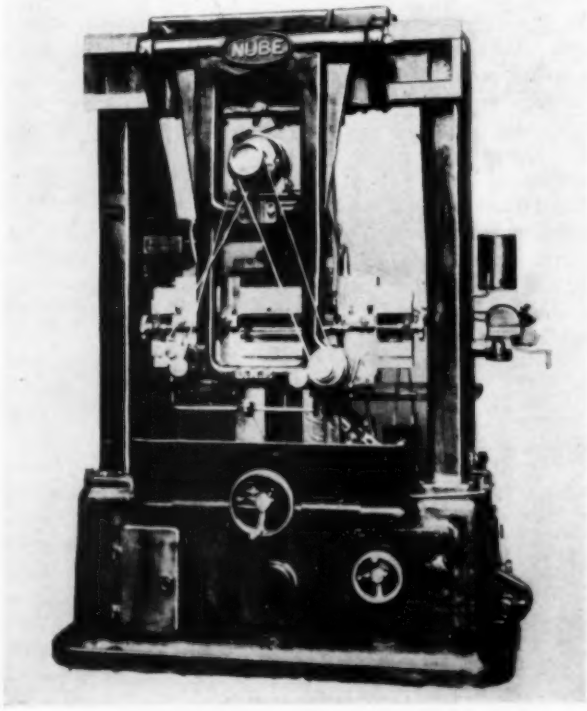
Wells No. 130 Grinder for routing cutters

the flat side of the emery wheel. For straight cutters like Nos. 2 and 3, a quill can be furnished with an eccentric hole to take ¼-in. cutter shanks.

Curd Model AGF Automatic Die-Sinking and Die-Copying Machine

For the manufacture of drop-forging and embossing dies and of molds for plastics and die-casting, as well as other hot and cold dies, the Model AGF automatic die-copying and die-sinking machine is being offered in the United States by the Curd Nube Machine Co., 117 W. Lake St., Chicago, Ill. This company represents the Curd Nube Machine Co., Offenbach, a/Main, Germany. The machine copies from an old die or from a model made for this purpose in the ratio of 1:1 and to a maximum size of 16½x8 in. Little hand finishing is required. The machine produces tools singly or in production. It is possible to use very fine pointed milling cutters such as are used for engraving, in addition to the normal cutter of about ¼ in. in diameter.

The automatic longitudinal and vertical feeds are adjustable in four steps. Both traverses can be adjusted to the exact size of the work. Behind the machine is fixed a table on which finishing work with the aid of high-speed flexible shaft is done. A special milling cutter grinding apparatus is fixed to the side of the machine. The collet chuck takes up to ⅝ in. diam. Drive is effected by a motor fixed on the base. Net weight of the machine is 3,720 lb.



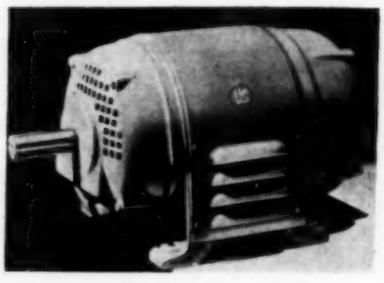
Drop-forging dies, embossing dies and molds for plastic materials can be made on the Curd Model AGF Automatic Die-Sinking and Die-Copying machine. An attachment is furnished to cut a left-hand die from a right-hand pattern or vice versa

"Hercules" Hoist with Safety Governor

A high-speed hoist with a patented safety overload governor is the most recent addition to the line of hoists manufactured by the Chisholm-Moore Hoist Corp., Tonawanda, N. Y. The overload governor warns against dangerous overloads and protects the hoist, load and operator against accidents. Another feature is the adjustable load brake which prevents self-lowering of the load. A quick lowering feature is available in the smaller capacity hoists to speed up handling in the production line. Gears are packed in grease in an oiltight housing. Capacities range from ¼ to 40 tons. The hoist is equipped with electric-welded "Inswell" load chain.

"U. S." Inclosed Explosion-Proof Motor

Two inclosing frames, with a large fan mounted between the frames, are employed for the explosion-proof motor developed by the U. S. Electrical Mfg. Co., Los Angeles, Calif. The inner frame incloses the windings, stator, rotor, anti-friction bearings and bearing chambers. The outer frame completely covers and protects the whole unit. Cooling air passing between the two frames does not come in contact with the windings or rotating parts. Windings are insulated with asbestos and impregnated with "Asbestosite." Die-cast aluminum is employed for the rotor, and the inner shell is of cast steel. The terminal chamber is of cast metal, machined to fit the motor frame.



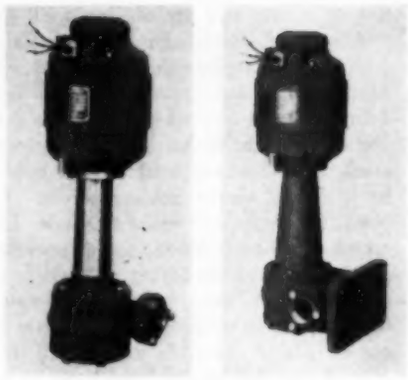
Gatke Molded Non-Metallic Bearings

Non-metallic bearings composed of a special textile base impregnated with synthetic resins, molded under high pressures and manufactured in all shapes and sizes, are now offered for general machinery uses by the Gatke Corp., 228 N. La Salle St., Chicago, Ill. These bearings have been used previously for steel-mill service. They are molded of three basically different materials for various services: Hydrotex, Lubritex and Grafitex. Hydrotex bearings are recommended to run in water or where water is available for lubrication. Lubritex bearings are designed for oil lubrication. Grafitex bearings are self-lubricating and are made for slow moving machinery where dirt and grit are encountered or where lubrication is apt to be neglected.

These bearings can be molded to dimensions with inserts and no machining is necessary. They have a low coefficient of friction and are not affected by ordinary acids, chemicals, solvents or salt water, and are not softened by oils or greases. The bearings are furnished for journal diameters from ⅛ to 24 in.

"Gusher" Vertical Motor-Driven Coolant Pumps

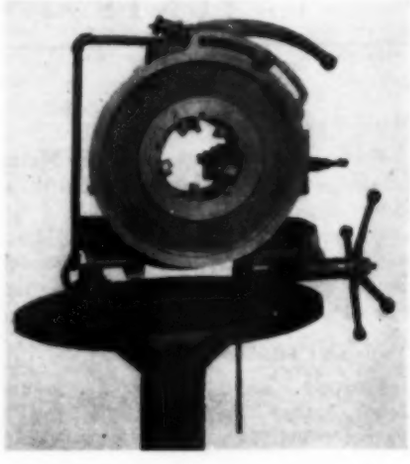
Two vertical motor-driven pumps added to its line by The Ruthman Machinery Co., Cincinnati, Ohio, show several new features. Twin suction intake, accomplished by two compartments communicating independently with the lower and upper sections of the impeller, maintain hydrostatically balanced thrust. Self cleaning is accomplished automatically when partially or totally throttled by internal agitation which exerts pressure outward through the intakes. No bearings are located below or in contact with the coolant which might be loaded with abrasive matter. The totally inclosed motor has a bowl-shaped disk fan above the windings. Location of the fan at this point prevents excess oil from the top bearing as well as dirt or chips from entering the inside of the motor. The reversible housing enables changing the relation of the discharge with the intake to either right- or left-handed.



Cusher Coolant Pump at left for mounting in reservoir. The pump at right is for exterior mounting

Oster-Williams No. 706 Diehead

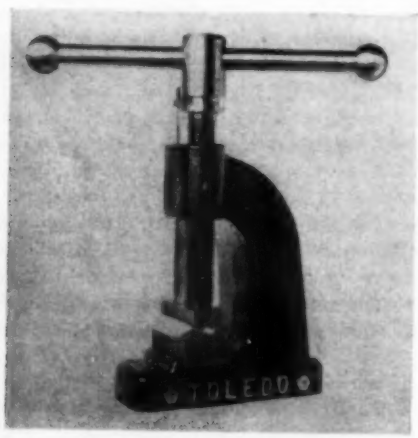
The Oster Manufacturing Co. and the Williams Tool Corp., Cleveland, Ohio, have brought out a No. 706 diehead which can be used to modernize old pipe machines. Capacities of the diehead are threads from 1 to 6 in. and bolts from ¾ to 6 in. can be cut. A micrometer adjustment for over or undersize threads is standard equipment. The threading dies are of high speed steel,



five to a set, and are of the small segmental type, mounted in holders. Single segments are replaceable. For pipe work one set of dies threads all sizes from 1 to 2 in. and one set from 2½ to 6 in. Die holders are of hardened and ground steel, and dies are held in the holders by a special socket holding screw. The head is equipped with a single high speed cutting-off blade, screw operated. Reaming and chamfering of pipe is accomplished in one operation by means of a special forming tool mounted on the cut-off slide. Threads up to 4 in. long can be cut for oil field work by means of special dies and holders.

Toledo Open-Side Pipe Vise

The jaw construction permits working close to the face of the open-side vise announced by the Toledo Pipe Threading Machine Co., Toledo, Ohio. The vise will hold copper as well as iron or steel pipe. The jaws are made of tool steel, and are easily replaceable. Handles are oversize to give considerable leverage. Three sizes are built as follows: No. 00, capacity ⅛ in. to 1½ in. pipe; the No. 0, capacity ⅛ to 2½ in.; and No. 3, capacity ⅛ to 4½ in.



• PATENTS •

APRIL 11, 1933

Metal-Working Machinery

Press for Drawing Sheet Metal. Charles Joseph Rhodes, Wakefield, England. Patent 1,903,475.

Grinding Machine. Roger N. Heald and Edward M. Taylor, Worcester, Mass., assigned to the Heald Machine Co. Patent 1,903,562.

Tools and Attachments

Floating Tool. Lewis Skeel and John Arthur Spohr, Meadville, Pa. Patent 1,903,576.

APRIL 18, 1933

Metal-Working Machinery

Machine Tool Slide and Lubricator Therefor. John R. Johnson, Rockford, Ill., assigned to The Ingersoll Milling Machine Co. Patent 1,903,865.

Mechanism for Reciprocating Grinding Wheel Spindles. Waldo J. Guild, Worcester, Mass., assigned to The Heald Machine Co. Patent 1,904,044.

Grinding Machine. Frederick S. Haas, Cincinnati, Ohio, assigned to The Heald Machine Co. Patent 1,904,045.

Device for the Control of Electric Arc Welding Machines. Jean Achard, Paris, France. Patent 1,904,112.

Method and Machine for Grinding Chasers. Ralph E. Flanders, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,904,304.

Tapping and Drilling Machine. Frederick H. Kind, Manitowoc, Wis., assigned to W. Gaterman Mfg. Co. Patent 1,904,375.

Grinding Machine. Charles G. Hunt, Cincinnati, Ohio, assigned to Cincinnati Grinders, Inc. Patent 1,904,642.

Milling Machinery. Lester F. Nenninger, Cincinnati, Ohio, assigned to the Cincinnati Milling Machine Co. Patent 1,904,649.

Metal Fabricating Machine. (Tubular Metal.) James Lucian Adams Jr., East Chicago, Ind., assigned to Graver Corp. Patent 1,904,913.

Lathe. Herman W. Melling, Jackson, Mich. Patent 1,904,949.

Milling Machine. Hans Ernst and Lester F. Nenninger, Cincinnati, Ohio, assigned to The Cincinnati Milling Machine Co. Patent 1,904,971.

Metal Cutting Machine and Control System Therefor. Walter F. Babcock, Detroit, Mich., assigned to The Foote-Burt Co. Patent 1,904,975.

Tools and Attachments

Spring Chuck. Claus Wilheim Faust, Elmwood, Conn., assigned to The Hess-Bright Manufacturing Co. Patent 1,903,964.

Cutter and Cutting Spiral Bevel Gears. Ernest L. Fickett, Fitchburg, Mass., assigned to Manning, Maxwell & Moore, Inc. Patent 1,903,988.

Welding Torch. Harry W. Tobey and Harold V. May, Pittsfield, Mass., assigned to General Electric Co. Patent 1,904,104.

Thread Testing and Recording Device. Peter Garms, New York, and George Lewis Diggles, Flushing, N. Y., assigned to Electrical Testing Laboratories. Patent 1,904,130.

Work Holding Mechanism. John E. Lovely, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,904,152.

Stud Setting Tool. Reinhold A. Norling, Aurora, Ill., assigned to Independent Pneumatic Tool Co. Patent 1,904,322.

Tool for Cutting Gears. Ernst Wildhaber, Brooklyn, N. Y., assigned to Gleason Works. Patent 1,904,584.

Milling Machine Collet. Walter D. Archea, Cincinnati, Ohio, assigned to The Cincinnati Milling Machine Co. Patent 1,904,641.

Mechanism for Producing Curved Axial Surface on Rolls. Harper A. Good, Waynesboro, Pa., assigned to Landis Tool Co. Patent 1,904,827.

Floating Chuck for Tapping Machines. William D. Rigney, Port Chester, N. Y., assigned to Russell, Burdsall & Ward Bolt & Nut Co. Patent 1,904,883.

Processes

Method of Cutting the Teeth of Gears. Oliver G. Simmons, Lakewood, Ohio. Patent 1,904,956.

• TRADE PUBLICATIONS •

ABRASIVE BANDS AND WHEELS. Bull. No. A-100 being distributed by the Abrasive Engineering & Sales Corp., 10630 Beread Rd., Cleveland, Ohio, describes "Nolap" abrasive bands and expanding polishing wheels.

DROP HAMMERS. The Pneumatic Drop Hammer Co., 123 Heath St. (Roxbury District), Boston, Mass., has published a circular on its double-acting pneumatic drop hammer described in this number. The drop hammer is a shockless type that requires no special foundation and can be placed on an ordinary shop floor for production of small parts.

LATHES. Circular No. 9-G, available from the South Bend Lathe Works, South Bend, Ind., completely describes the 9-in. No. 20 "Toolmaker" motor-driven lathe recently announced. Prices, specifications, accessories, and photographs of the various models and of the types of work done are found in the circular.

PIPING MODERNIZATION. Crane Co., 836 South Michigan Ave., Chicago, Ill., is now distributing two mailings as follows: "Born of Retrenchment," and "After 8 Years of Starvation Maintenance," each with product circulars enclosed to show new designs of valves and fittings, the latter for welded construction. These messages are guides to determine efficiencies of existing piping and to achieve economies by alterations. They concisely show how modernization can be achieved.